MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

PACIFIC NORTHWEST REGION—STATE AND PRIVATE FORESTRY

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HARVESTING YOUR DOUGLAS-FIR FOR MAXIMUM INCOME

Trees are a crop. However, unlike most other crops, they cannot be harvested a few months after planting. It normally takes 20 to 30 years after an area is seeded or planted before the trees have a merchantable value. The trees increase in diameter and height each year at varying rates. When growing conditions are favorable, there is a rapid increase in size. When trees have to compete with each other for moisture or sunlight, growth is retarded.

The young trees grow rapidly until their branches meet and they start competing for sunlight. At about the same time their roots start to compete for moisture and soil nutrients. As a result of this competition, all of the trees grow at a slower rate. As the competition continues, the weaker trees are shaded and killed by the stronger or dominant trees. This causes an annual reduction in the number of trees until the stand reaches maturity. Even when of merchantable size, these dead trees are seldom harvested since there are only a few per acre each year and insects or disease destroy their value very quickly. The remaining trees have had their growth slowed by the competition so have taken many more years to reach commercial size.

A tree growing with limited competition on most Douglas-fir lands can increase 2 to 4 inches or more in diameter in 10 years. As long as this rate of growth continues, the tree is increasing in volume and value at a maximum rate and harvesting should be delayed. If growth slows down because of competition from other trees, it can be restored by cutting the competing trees and leaving more space for the remaining trees to grow.

Any thinning during the first twenty years will probably be unmerchantable but the selected trees remaining will be stimulated to reach commercial size sooner. After 20 years, the trees cut in thinnings are often of merchantable size and can be sold at a profit. Several such thinning operations are needed to maintain rapid growth of the crop trees. A final clear-cut harvest of the area should be made at the end of the established rotation when the annual growth becomes slower. Mature timber stands often suffer losses from insects, disease and other factors equal to or in excess of the annual growth. Such stands are not increasing much in net volume or in value and should be harvested to allow establishment of a new fast growing stand.

FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

The main factors to consider for maximum production and income from a Douglas-fir forest are as follows:

1. Utilize all of the land to full capacity with a forest crop.

2. Maintain a good growth rate.

3. Utilize as much of the wood growth as possible.

4. Grow and sell quality products (peeler logs, poles, sawlogs).

5. Harvest mature products when the market is best for that particular product.

Care in felling trees to be harvesed is important in the small amount of damage likely to the remaining trees and the minimum loss to the trees cut due to breakage.

Total values can often be increased by care in harvesting to avoid damage and consideration of defects when bucking the tree into logs. The volume and grade of a log can often be increased by cutting it 2 to 4 feet shorter to avoid a defect or limb cluster. Loss from crook can be reduced by cutting shorter logs. When cutting logs of varying length, keep the lengths within the range wanted by the mill.

The results of repeated thinnings at 4 to 5 year intervals from age 10 to approximately 60 years is shown in the following theoretical thinning schedule. Crop trees have been selected early so that each time the stand is thinned each crop tree is given some further release. As a result, each crop tree grows faster than normal and tree diameters and commercial volumes per acre increase.

Income from thinnings at 5-year intervals is greater as tree diameter increases.

Recovered values can often exceed those from sawlog production if some of the volume can be harvested as poles and piling.

Periodic thinnings are repeated until only the trees designated as crop trees are left.

At 63 years of age, as shown on the table, only selected crop trees remain. At this point, the owner has a choice of several procedures:

1. He can clear-cut the area and get his stumpage volume as shown. This would be unwise as trees at this age are usually growing at a rapid rate.

2. He can again thin the stand to promote growth of the remaining trees and prolong the harvest.

3. He can leave all of the trees for 10, 20 or more years to gain additional size and value.

Since we have no record of well managed stands thinned periodically for 60 years, we have developed this table on a theoretical basis to indicate the growth rates and volumes that may possibly be obtained. The diameters and volumes shown are based on an assumption that early growth is at the rate of 4 rings per inch, dropping to 5 rings per inch at 18 years of age and maintaining that rate of growth. Average tree diameters of the stand are used according to the method developed on pages 64 to 70 of Technical Bulletin #201 (Revised Oct. 1959) "The Yield of Douglas-fir in the Pacific Northwest".

THEORETICAL THINNING SCHEDULE FOR GROWING DOUGLAS-FIR STANDS

Computation of a theoretical thinning schedule calculated to maintain a rate of growth of 5 rings per inch on a maximum number of trees, starting from a 7x8 spacing (778 trees) and frequent thinnings favoring the 100 crop trees per acre. After 20 years of age, all trees from thinnings are harvested commercially.

(1)	(2)*	(3)*	(4)*	(5)*	(6)	(7)	(8)	(9)	(10)	(11)	(12)
			Volume Per Average Tree			Number Trees Per Acre			Volume -- Scribner Rule Bd.Ft. Per Acre to 8" Top		
Age	Average DBH of Stand	Total Ht.	Cu. Ft. to Tip	Bd. Ft. to 8" Top Scribner	Basal Area Per Average Tree	Before and After	Trees Cut	Basal Area Per Acre (Col.6x7)	Before Thinning (5x7)	In Trees Cut (5x8)	In Trees Left (10-11)
(Years)	(Inch)	(Feet)	(Cu.Ft.)	(Bd.Ft.)	(Sq.Ft.)	(No.)	(No.)	(Sq.Ft.)	(Bd.Ft.)	(Bd.Ft.)	(Bd.Ft.)
10	2	22	.2	--	.0218	778	100	17.36	Some products may be cut from early thin-		
14	4	39	2.0	--	.0873	678	100	59.18	nings, such as Christmas trees,posts,etc.		
18	6	55	5.1	--	.1963	578	100	113.46	--	--	--
23	8	69	10.9	11	.3491	478	100	166.87	5,258	1,100	4,158
28	10	83	19.6	43	.5454	378	100	206.16	16,254	4,300	11,954
33	12	97	31.5	99	.7854	278	50	218.34	27,522	4,950	22,572
38	14	110	46.6	184	1.0690	228	40	243.73	41,952	7,360	34,592
43	16	123	65.0	296	1.3963	188	30	262.50	55,648	8,880	46,768
48	18	135	87	429	1.7671	158	25	279.20	67,782	10,725	57,057
53	20	147	112	593	2.1817	133	20	290.17	78,869	11,860	67,009
58	22	157	142	779	2.6398	113	15	298.30	88,027	11,688	76,342
63	24	167	175	999	3.1416	98	12	307.87	97,902	11,988	85,914

*Columns 2, 3, 4 and 5 taken from "The Yield of Douglas-fir in the Pacific Northwest", Technical Bulletin #201, revised 10/49 (Page 68).

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THIN YOUR WEST SIDE DOUGLAS-FIR WOODLOT

CONTENTS

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FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

If you are happy with your woodlot as it is – read no further! If you wish both income and enjoyment from your woodlot – read on!

THIN YOUR WEST SIDE DOUGLAS-FIR WOODLOT

FOREWORD

"Thin Your West Side Douglas-fir Woodlot." This is a deliberately restrictive title. It attempts only to describe how to thin the Douglas-fir found west of the Coast Range in British Columbia, the Cascade Range in Washington and Oregon, and the Sierra Nevada in northern California. This is the green variety of Douglas-fir; the blue, or Rocky Mountain variety is found east of these mountain ranges from Canada south into Mexico.

Today no publication on natural resources is complete without an environmental statement. How does thinning affect our environment? Thinning is a plus all the way where the environment is concerned. It removes dead, dying and decadent trees, and only the vigorous remain. Aesthetically, too, thinning is pleasing. A woodlot where only vigorous, healthy, well spaced trees remain is an attractive sight. A woodlot that has been opened up and roaded is an enjoyable place to walk or picnic. Few people really enjoy forcing their way through a tangle of brush, or a woodlot where trees grow so close together you have to struggle to move. This is the case in too many woodlots. Most forms of wildlife can live as well or better in a thinned stand than an unthinned one. They need both shelter and a variety of food. A thinned watershed will produce as much, if not more, water for downstream use than an unthinned one. Where the thinning is skillfully done, and the roads well built, the runoff water should be as clear as that from an unthinned woodlot.

Forty-year-old stand being marked for thinning. This farm stand would now be producing more income, had it been properly cared for at an earlier age.

A. INTRODUCTION

Our yesterdays are canceled checks!

Our tomorrows – promissory notes!

Our todays are cash!

Thin your woodlot!

Who should do it? You should do it! Idle acres will not pay the taxes levied against them.

What is thinning? Thinning is removal of some trees to put more wood on the trees you leave.

Why? It is done to provide growing space! You can't afford to support lazy acres. You pay taxes on every acre, so every acre on your property should produce income. A thinned forest is a healthy forest.

When? Ideally, you thin before the branches of adjoining trees interlock. This indicates the trees are crowding each other for light, moisture and nutrients. This slows tree growth.

How? This publication will attempt to tell you how. It lists where you can go for help. It provides a number of references for you who have the time, interest, and desire for more information.

B. GROWTH CAPACITY OF DOUGLAS-FIR LANDS

How much of a timber crop will average forest land grow, if it is kept well-stocked

with thrifty Douglas-fir trees? An example is given in Table 1. The yields shown are for unmanaged stands of Douglas-fir on soils of average timber productivity. In a study begun in 1880 the Danes have improved these yields by 30 percent to 70 percent with intensive management of planted Douglas-fir in Denmark. Good timberland will produce as much as double the amounts shown in Table 1, poor land, perhaps one-half as much.

Table 1 — Expected Yield of Wood from Douglas-fir Forests at Different Ages 1/

Age	Cordwood 2/	Saw timber 3/
Years	Cords	Board feet Scribner
20	6	
30	24	500
40	48	5,400
50	72	14,300
60	91	26,500
70	107	37,900
80	120	47,800
90	131	55,800
100	141	61,900
110	150	66,700
120	157	70,500

1/ Derived from USDA Technical Bulletin No. 201.

2/ In trees 6 inches and larger in diameter.

3/ In trees 12 inches and larger in diameter.

Notice that between the ages of 40 and 60 years, cordwood volume almost doubles, and the volume of saw timber in board feet more than doubles and redoubles. From 60 to 90 years, saw timber volume also doubles again. This shows the tremendous growth of timber to be gained when forest lands are kept well-stocked. It also shows the great loss in timber yield that results when young forests are clear-cut during their most rapid period of growth. Greater still, is the loss when forest lands are not promptly restocked with trees.

As young forests grow to maturity, the value of their timber usually increases even more rapidly than their volume. More high quality lumber can be cut from larger logs. Fortunately, it is neither necessary nor desirable to delay thinning in young Douglas-fir until the high yields shown in Table 1 would be obtained. In fact, the total volume and value of the timber harvest can be made even greater through more frequent thinnings. The value of smaller material has steadily increased due to improvements in technology and markets in the wood using industry. Commercial thinning and the sale of small material became possible after a modest beginning in 1955.

C. WHO WILL THIN?

There are about 53,000 people in the Douglas-fir region who own 1 to 100 acres of timber land. Their holdings average about 35 acres. These total over 1,900,000 acres. Were all this in full production, it would be making a substantial contribution to the Nation's wood supply. It would also provide much more income to the owners than they are now getting. Many of these nearly 2,000,000 acres may support no trees at all. These acres are the subject of pamphlets on reforestation, for example, "How To Do It Guide No. 11." If your acres have a stand of immature timber whose branches interlock (generally less than 50 years old) you should be thinning. You owe it to your trees, your land, and your pocketbook.

You may need information on tree growth. You may need expert help and advice.

D. WHAT IS THINNING?

In the introduction we said that thinning is transferring wood to the trees you wish to bring to maturity. In the Pacific Northwest many young stands (10 to 50 years old) have more trees per acre than is desirable. Gardeners and farmers thin and weed radishes and carrots. Woodland owners thin and weed forests. The same principle applies in both situations. An acre of ground will produce only so many top quality carrots, radishes, or trees.

1. **Commercial and Precommercial.** Thinning may be either commercial or precommercial, depending on whether or not the material can return costs and show a profit. A precommercial thinning is cutting seedlings and saplings too small to sell. It is an investment in the future. A commercial thinning is done in larger stands where the trees cut can be sold.

Precommercial thinning. Firewood and corral poles are stacked. They help defray the cost of thinning.

Crown release following thinning.

2. **Which Trees are Removed?** In order of priority these are:

a. Unhealthy low-value competing trees.

b. Merchantable trees that might not survive until the next cut—unhealthy looking or diseased trees.

c. Defective trees—those with sweep, crook, rot, broken tops.

d. Those with poor crown development—trees with thin, spindly tops may never grow a good crown; or at least, may take too long to do so.

3. **Thinning Methods.** There are three thinning methods. These are:

a. Low—This gives priority to removing the overtopped (suppressed) trees. These might decay and die. After the suppressed have been cut and those described in 2 a-d, it may be necessary to cut individual trees that crowd others.

b. Crown—Some of the larger trees are harvested, but the most promising trees in the upper crown class are left. Being vigorous to begin with, these trees will develop even faster and return more money at final harvest.

c. Selection—This removes the rough super-dominants[1] plus competing trees. The selection thinning often provides the greatest immediate return from the first thinning. It may delay harvest of fully grown trees.

E. WHY THIN?

Study of available data indicates that nearly 30 percent of all Douglas-fir stands in western Oregon and Washington are less than 40 years old. Well tended farms produce bumper crops. Well tended forests can do the same. Thinning can upgrade a nondescript collection of trees into a working forest. It cannot, however, improve understocking.

Thinning removes unwanted species.

Thinning relieves overcrowding, increases growth rates and per acre yields.

Thinning improves potential crop trees.

Thinning removes mortality, culls, deformed, defective, and unmarketable trees.

Thinning sanitizes a stand, removes trees harboring insects and diseases, thus reducing mortality from bark beetles.

Studies have shown that skilled thinning reduces losses to windthrow. This is true even for high windthrow hazard areas.

1/ A dominant tree is one whose crown is well above the general canopy of the stand.

Stand planted in 1914–thinned in 1959. Thirty percent of the board foot volume removed. Spacing is 18 feet and leaves 134 trees per acre.

Unthinned portion of the same stand.

Sooner or later, every tree must die through natural causes or harvests. You want each of your trees to realize its full potential. You wish to increase your income from each tree. Most stands start with far more trees than will reach final harvest cut. Skillfully done, thinning can help increase the growth of each tree, regardless of time cut.

Short "whippy" tops do not possess the foliage to provide enough food to keep the tree growing rapidly. Leave trees with full crowns where possible. (One-third or more of total length in crown.)

In summary, stands are thinned for five reasons; two are growth related (silvicultural), and three are economic:

1. **Silvicultural Advantages**

 a. To achieve proper spacing.

 b. To benefit crown development. The crown is the factory that develops the materials needed for growth. Anything that helps crown development helps the tree.

2. **Economic Advantages**

 a. Thinning salvages mortality. You may recover stems that would otherwise rot and benefit no one.

 b. Thinning removes defective or unwanted trees. These occupy space and will contribute little to the stand now, or in the future.

 c. Thinning recovers volume and value that would otherwise be lost due to overcrowding and retarding of growth.

On better soils, records for an 80-year-old stand showed total recovery of 125,200 board feet per acre, of which 57,400 board feet came from thinning. (Total thinned plus harvest volume.) A stand on poor soil first partly cut at age 39 gave a total recovery of 42,700 board feet per acre of which 17,200 board feet came from thinnings.[2] Convert these figures to dollars when you know what logs sell for in your area!

Another Douglas-fir stand on an average growing site was thinned frequently, starting when the trees were 13 years old. At 42 years of age, the trees were compared with a normal, unthinned stand growing under the same general conditions. Results are shown in Table 2. The figures speak for themselves!

As illustrated, competently done thinning develops adequate tops, roots, and healthy trees less susceptible to insect and disease

2/ The Forest Log, State of Oregon Department of Forestry, Vol. 41, No. 2, 1971, pp. 4 & 5.

Table 2—Per Acre Measurements of Thinned and Unthinned 42-Year-Old Douglas-fir Stands 1/

Treatment of Douglas-fir stand	Average diameter of trees	Total number trees	Removed earlier	Presently standing		Value at $50/M bd. ft.
	Inches	Number	Cords	Cords	Scribner bd. ft.	Dollars
Unthinned	7.8	554	None	53	6,100	305
Thinned	13.3	207	26	73	25,500	1,275

1/ Extension circular 318, Washington State University

damage. It also allows you to collect the interest and keep part of your capital intact. It shortens the time required for your trees to reach economic maturity.

F. WHEN TO THIN

You thin before branches begin to interlock. Branch interlocking indicates the trees are crowding each other for light. It is a sign that their roots are competing for moisture and nutrients. When this occurs, regardless of age, it is time to thin.

Commercial thinning returns income before fully mature trees are cut. Keep an eye on log prices. Thin when the price is right. Done thus, you can sometimes increase both tree growth and your financial returns. Not a bad combination!

Thinning can be done any season of the year in Douglas-fir (weather permitting). More care must be used in the spring when the bark is slipping. Rot can easily develop where the bark is knocked off trees.

Thinning can be done in frequent, light cuts, or in heavier cuts at longer intervals. The determining factors include stand age, accessibility, nearness to markets, products (Christmas trees, fence posts, car stakes, firewood, pulp, poles, piling, sawlogs, etc.), the availability of loggers, truckers, and other factors.

Frequent, light cuts (every 3 to 5 years) can increase total yield. Heavier cuts (one to three or more times in the life of a stand) yield less total overall wood, but may be more convenient. Heavier, less frequent cuts require greater attention to detail. Errors are more difficult to remedy.

In thinning, encourage the growth of the best trees. Don't try to revive those that have fallen behind. Thin your fastest growing stands first. Then, move to the next most productive stand. Continue this process until you have worked over your total ownership.

The first thinning removes the dead, dying, diseased and decadent trees. Huge limby trees and competing hardwoods are taken too, if markets permit. Mark trees to be cut with an eye on the remaining trees. Keep spacing in mind. (See Page 7)

Choices become more difficult with the second and subsequent thinnings. Continue to leave well-spaced, tall, well-formed trees.

G. HOW IS THINNING DONE?

The easiest way is to hire a competent consultant and have him arrange the logging and marketing. You should, however, know enough about thinning to be able to judge whether or not a good job is being done. This is why it is well to have your Service Forester's advice, some knowledge of thinning, and some knowledge of your stand before hiring a consultant or attempting the job yourself.

A well-planned job results in cheaper operating costs. Careful logging need be no more expensive than a careless job. Skilled logging will leave the remaining stand in good shape and send more wood to the mill. A careless job can result in excessive breakage of

marketable material and much damage to the remaining trees.

Where do you start? First, you study what you have. Do you have Douglas-fir, spruce-hemlock, hardwoods, or a mixture of species? Your Service Forester can help you with tree identification.

How big are they (2 inches or over 20 inches)? Examine a representative sample, taking measurements 4-1/2 feet above the ground. (This is known as DBH, or the diameter breast high.) Develop an average diameter figure. How many (700 per acre–200 per acre)? Take plots–count trees. Ask your Service Forester or study some of the references given (see Page 11) to learn how to take plots and develop a sample. This sample can be used to provide an estimate of the kind of a job that needs doing and the amount of merchantable and/or unmerchantable wood that must be moved.

Diameter + 4 (D + 4), this is a tree spacing formula. The following examples explain its use:

Precommercial thinning–

Average tree diameter is 3 inches. Add 4.
Average spacing becomes 3 + 4 or 7 feet.
This leaves 889 trees/acre @ 7-foot x 7-foot spacing.

Commercial thinning–

Average tree diameter is 16 inches. Add 4.
Average spacing becomes 16 + 4 or 20 feet.
This leaves 109 trees/acre.

Spacing cannot be exact. D + 4 or any other formula can only be a guide to the actual number of stems to be left on an acre. The primary objective is to provide enough space for each individual "leave" tree to get its fair share of nourishment and sunlight. On rich soils, more trees can be left per acre. D + 3 could perhaps be used as a guide. On rocky shallow soils D + 5 might be advisable. When in doubt, consult a specialist.

What are your markets? Contact the mills. Get acquainted with the buyers. Can you sell firewood, posts, poles, piling, sawlogs, and peelers? What prices can you get? Service Foresters can provide information. The local paper also must be watched for marketing possibilities.

How do you get the wood out? Is there a road? Is there an old railroad grade? Are there streams? Where will you cross? How, by culvert, log stringer bridge, other? Where will the skidroads be located? How wide shall they be (one horse, tractor, small "dozer" or cable skidder)? Skid roads for pulp and short logs can be narrower and more crooked than those for long poles and piling. In short, you must decide where you will locate your main haul road, the skid trails, and landings.

Skidding with a rubber tired tractor.

Roads are expensive. Take advantage of existing roads. Locate new roads through natural openings where possible. Stay out of the very bottom of a draw. Wherever possible, stay up on benches. Usually anything more than 800 feet is an inefficient distance for tractor yarding. Where road construction costs are high, however, longer skidding may prove economical. For small tracts a short, steep (7 to 15 percent) outsloped road may be all that is necessary to get the wood out and provide future access for fire protection, management and enjoyment of your land. An outsloped road is one requiring no ditches and only a few culverts for drainage crossings. The roadbed has a sufficient downhill slant (outslope) to insure the runoff of water. Water must not be permitted to accumulate and erode your land. Roads are a prime source of erosion. Remember, your road will be used a number of times if you continue to manage your woodland. Balance "rocking"

Loading logs from a 60-year-old stand.

Thin and full tree tops.

against not rocking your road. Sometimes you can get a better price for your thinnings when the "dirt" shows in your area are shut down. Trucks are more readily available to the small landowners when truckers are "snowed out" of the high country. This alone may make rocking worthwhile. If you decide on rocking, have it done in the summer when things are dry. Winter rocking is a costly business. It takes more rock to do a good rocking job in the winter.

Is your land so steep (40 percent plus) that thinning must be done by cable? Are cable systems available in the area? Here, too, yarding roads must be decided upon. Landings must be located. Roads to these landings must be established.

You are now ready to thin. You know how many stems you have per acre, which products you could sell. Now you start. A word of caution: Leave a narrow unthinned strip on the windward side to help avoid windthrow within the stand.

1. **Precommercial Thinning.** What tools are available? Will you thin with a power saw or with chemicals? Where the average diameter of the young stems is more than 2-1/2 inches and there are less than 2,000 stems per acre, it may be cheaper to use chemicals. Monosodium acid methanearsonate (MSMA) or cacodylic acid (CA) may be used. Learn about these chemicals (silvicides). Decide which to use. These are poisons (arsenicals). CAUTION must be observed in their use. Silvicides can be applied with the "hack and squirt method." Chop a cut on a stem. Squirt a shot of the solution into the cut. Move to the next tree and repeat the process. One shot of this silvicide is usually sufficient to kill a small tree. For larger Douglas-fir it may be necessary to use approximately two cc's (about 54 grams) of chemical per inch of diameter breast high, making cuts every 2 inches around the tree. Labels on the can supply precise details of how much to use.

Chemicals have some advantages. The stems remain standing. The needles and the stem drop slowly. This provides moderate increases in the amount of light reaching the remaining stems. Little shock is experienced. No sunscald occurs. When your stands are opened abruptly, hot sunlight can bake tender young bark. This bark dies, as does the living tissue under it. Occasionally, death follows.

Machetes, axes, and power saws are used in mechanical thinning. Except for small diameters (2 to 3 inches), the power saw is the best tool for the job. Power saws are dangerous. If you haven't used one before, get instructions from a skilled user before trying it yourself. A pair of safety chaps is a good investment for any user. These chaps, filled

with layers of fiberglass or nylon, will stall a power saw before the whirling chain can reach your flesh. These can be obtained for about $20 from a safety supply house. (Less than the cost of a trip to the doctor or the loss of a few days work.)

Faller working in 32-year-old Douglas-fir stand, using power saw.

2. **Commercial Thinning**. The following outlines factors to consider when doing the logging. Where you don't have the equipment yourself, any one of these operations can be contracted. When contracting, always use a written agreement to protect yourself.

a. Falling and bucking. Will you contract this out or do it yourself? If you do it yourself, remember power saw safety!

It is usually cheaper to handle long lengths than short. You are, however, more apt to damage the remaining trees. Long lengths do, however, affect skid trail width and location.

Time a problem? Perhaps you can fall and buck during the winter and do the rest of the job during the summer.

b. Skidding. Skid trails should be built in advance. Trees should be felled toward these trails to minimize "barking" standing trees during skidding.

Skidding equipment can be small. Small machines usually do less damage than large ones (in the hands of a skilled operator). Horses can be used effectively where skidding distances are less than 300 feet.

Rubber-tired skidders are efficient for yarding logs and tree length material. They are faster than track type skidders. If logs must be yarded where rubber-tired rigs won't work, bunch with a "cat" at the main skid trails and skid to the landing with a rubber-tired tractor. This increases cost.

Where small volumes are to be moved, use a farm tractor rather than investing in heavy logging equipment. It isn't as efficient as specialized equipment, but is fairly satisfactory on gentle topography.

c. Loading and hauling. For small, second-growth operations, inexpensive loading equipment is essential. One cheap and satisfactory method is to hang a block in an A-frame, pass a line through the block and load with end hooks. You can use the same power source for the loading job. A small loading donkey (motor) will be more efficient if 20,000 board feet or more are handled daily. **Note:** End hooks can slip. Use extreme caution!

A loading dock can be used on small operations. Rollways are built on sloping ground at approximately the height of the proposed loads. The trucks park parallel to the dock and small logs can be rolled on with peaveys or a tractor.

Self-loading trucks are most efficient on small operations. You may contract the hauling to someone who has such a truck. Hauling rates will vary with hauling distance and road condition.

d. Supervision. Good logging requires good supervision. The man in charge must be capable of running an efficient operation. He must maintain safe working conditions for the crew and guard against damage to uncut trees. Normally, it is good business for an inexperienced timber owner to hire a capable man to take charge of the woods part of a logging operation. Contracting part of the job can reduce the amount of supervision he must do. Contract work is advisable for hauling and at times for falling and bucking, provided he exercises sufficient control to get an acceptable job.

The man in charge must see that all employees work under safe conditions and that each man is careful to avoid accidents. Personal injuries and equipment damage are costly to any operation. There is no substitute for caution and good judgment by everyone on the operation.

H. ESSENTIAL INFORMATION NEEDED

Essential information needed includes, but is not limited to, the following:

1. **Road Costs.** These are crucial. Get several estimates from reliable contractors. Road costs can be a major reason for not thinning. Early thinning returns may not cover this essential cost. Precommercial thinning definitely won't!

2. **Taxes.** Knowledge of the local tax problems and options is vital to an owner about to begin a thinning operation.

3. **Administration.** Adequate records are needed to keep track of taxes, insurance, costs, market values, payroll deductions for social security, health and accident insurance, etc.

4. **Protection.** Fire protection is essential! Know the location of the nearest fire protection unit. Know and observe State fire prevention rules. Your operation will be checked for compliance periodically.

5. **Cutting Permits, Slash Clearances.** Laws, policies, rules, and regulations must be understood in advance. Expert help is available without charge in most counties. (See Section I, 1 through 4.)

6. **Insurance.** Protecting labor, equipment, and timber resources, requires decisions on coverage before cutting begins. Without liability insurance, you can lose your life savings in a minute. Workers are due compensation for labor-connected injury.

7. **Regeneration.** Plans for a new crop must be made in advance of final harvest. Waiting to see if trees come back naturally may mean losing control of good sites to brush.

8. **Other Considerations.** The best information at low cost on many of the following is desirable:

a. Property lines and corners.

b. Snag and slash hazards.

c. Topographical features.

d. Trespass potential, adjacent owner's record.

e. Summer shows,[3] winter shows, all-weather slopes.

f. Available aerial photos, topographic maps.

Preplan alternative logging shows. Log your dirt show while it is dry. Save the protion of your woodlot that you can yard to an all-weather road for wet weather. If you have enough land to do thinning both summer and winter, try not to operate a summer show in winter months.

g. Breakdowns. Remember that even with a skilled operator equipment delays are more frequent in wet weather and on rough terrain. Breakdowns cost heavily in time and replacement parts.

I. AVAILABLE ASSISTANCE

1. **Consulting Foresters.** The consulting forester returns his fee manyfold. (Check the yellow pages for Foresters, Consulting.) Your Service Forester can provide a list of those working in your area.

2. **Information and Technical Advice.** State Service Foresters and Extension Foresters furnish information to woodland owners. Contact the State Foresters in Salem or Olympia; or any U.S. Department of Agriculture (USDA) office for their names and addresses. The USDA maintains offices in nearly every county seat. Assistance with planning, management and protection of your forest property is available from these offices.

3. **Conservation Planning.** Those living in any Soil and Water Conservation District can obtain help. The Soil Conservation Service

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3/ Show = logging operation.

offices can provide information about timber stand improvement. The Soil Conservationist will help you develop a plan to protect and improve your resources. The plan will include a soil map with interpretations for the appropriate land uses.

4. **Loans.** Under certain conditions the Farmers Home Administration can provide funds for thinning. Consult their local office for information.

5. **Forest Cooperatives.** In some areas forest cooperatives exist to serve their members by selecting loggers, writing appropraite contract terms, paying out logger and landowner shares of the log revenue, marking trees and otherwise supervising the logging operation. Your Extension Forester can put you in touch with a cooperative if one exists in your area.

6. **West Coast Tree Farm System.** Industrial Forestry Association, 1410 S.W. Morrison, Portland, Oregon 97205. This organization provides inspection and assistance with the management of tree farm property.

J. THE FUTURE

New demands, new machines, and new methods are making thinning more practical all the time. Timber considered worthless 10 years ago may be valuable 10 years hence, or even today. By keeping alert to these developments, you may improve your timberlands and your bank balance. Land taxes alone make it smart to keep abreast of every possibility for profit. The conditions that made previous thinning pamphlets obsolete will continue to exist. Your forest land is ever changing.

K. REFERENCES

Management of Young-Growth Douglas-fir and Western Hemlock. Proceedings of a symposium held June 10-14, 1968, edited by Alan B. Berg, School of Forestry, Oregon State University, Corvallis, Oregon

Managing Young Douglas-fir and Western Hemlock Economics, Yield Control, and Thinning. Proceedings of a symposium held June 16-18, 1969, edited by Alan B. Berg, School of Forestry, Oregon State University, Corvallis, Oregon

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Precommercial Thinning of Coastal and Intermountain Forests in the Pacific Northwest, February 3-4, 1971, edited by David M. Baumgartner, Washington State University, Pullman, Washington

Woodland Handbook for the Pacific Northwest, A Guidebook for Pacific Northwest Woodland Management. Oregon State University, Corvallis, Oregon (Note: This is one of the finest references currently available on woodland management. In addition to articles by recognized authorities, it provides an excellent list of references for additional study. It can either be purchased from the Cooperative Book Store, OSU, or obtained from your local library.)

☆ GPO 797-343

PESTICIDE PRECAUTIONARY STATEMENT

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key – out of the reach of children and animals – and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first-aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the Federal Environmental Protection Agency, consult your county agricultural agent or State extension specialist to be sure the intended use is still registered.

PROTECT

Use Pesticides Safely
FOLLOW THE LABEL
U.S. DEPARTMENT OF AGRICULTURE

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

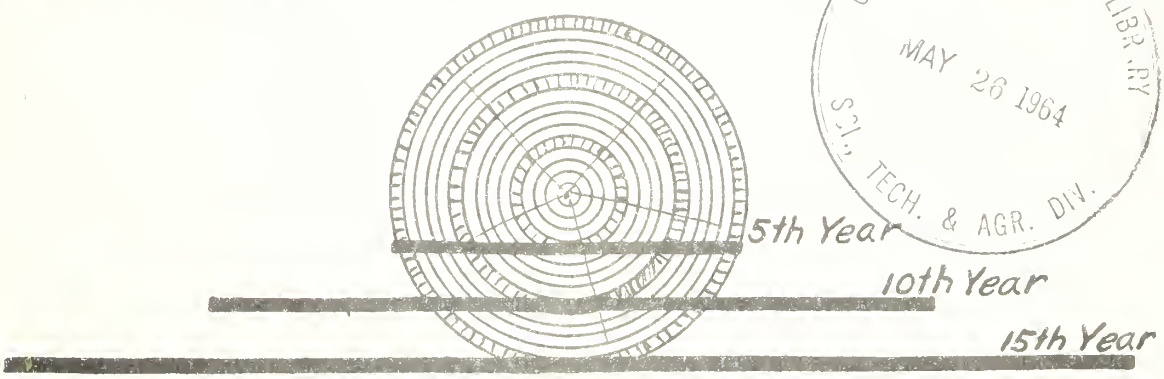
PACIFIC NORTHWEST REGION—STATE AND PRIVATE FORESTRY

No. 2 PORTLAND, OREGON June 1959

INCREASING VALUE AND VOLUME OF FOREST TREES

BY A BETTER GROWTH RATE

Your timber has value now. Should you sell it and start another crop of trees? Should you hold it another ten years and then sell it? Can you sell part of the trees in the stand now and have an increased value later? The answers will vary depending on the age, size and rate of growth of your trees. Your local forester can help you decide. He can show you how fast your trees are increasing in volume and in value. He may recommend thinning to accelerate the tree growth. He can show you when the future value of your trees can be increased by pruning.



ANNUAL WOOD-GROWTH INCREASE WITH LOG SIZE

Every 5th annual ring. Annual ring unrolled to show relative wood volume.

Each year a tree grows a new layer of wood just under the bark. This layer or annual ring varies in thickness depending on the vigor of the tree and the availability of water, soil nutrients and sunlight. If these elements are readily available to the tree, only a few annual rings are needed to grow an inch of wood. If too many trees occupy an area, less nutrients are available to each tree and the annual rings on all of the trees will be narrow and more years will be needed to grow an inch

of wood on each tree. A tree growing at a rate of 4 rings per inch will have twice the diameter and 7 to 10 times the board foot volume of a tree growing at a rate of 8 rings per inch for the same number of years. If a young tree grows at a slower rate than 8 rings per inch, there is an unnecessary loss of volume and value to the woodland owner.

The volume of a tree increases more rapidly in large trees than in small trees when the same number of rings per inch is maintained. This accelerated volume increase in the larger trees is due in part to the greater length of the band of wood put on around the tree. (See diagram on front page.) Larger trees also have greater height so wood growth is formed on more merchantable logs. Individual trees increase in board foot volume very slowly during the first forty years. Thereafter, the volumes increase more rapidly as the diameters increase. A tree grown at a rate of 4 rings per inch will have a volume of 359 board feet when it is 40 years old. If the tree grew at the same rate for another 10 years, the volume would increase to 779 board feet. However, if the rate of growth for the second 10 years was reduced to 8 rings per inch, the volume increase would be less than half as much or about 540 board feet.

As the size and volume of a tree increases, the tree value also increases (see accompanying table of Comparative Volumes and Values of Trees). This table assumes that all logs will have the same stumpage value of $20 per thousand board feet. However, logs from very large crowned trees "wolf trees" develop large knots that produce knotty lumber. Therefore, they are of low value. A sawmill operator will not pay as much for such logs. Large logs, without knots, will produce veneer or high grade lumber. A higher price can be obtained for these logs.

Pruning the limbs on the lower log of the fastest growing and best shaped trees will produce high quality material if the trees are left to grow in size. Since a large proportion of the tree volume is in the bottom log, pruning can greatly increase the value of that log and the total value of the tree.

How can you maintain or increase the rate of growth on your woodland? An acre of land can support only a limited number of trees at a maximum rate of growth. Cutting of some of the trees in a thinning operation and repeating each time the trees crowd each other will permit the remaining trees to grow at the maximum rate. Since the larger trees will increase in value faster than the smaller trees of the same age, it is better to keep these larger fast growing trees in the stand if they are well formed, full crowned trees. Wolf trees, defective or poorly shaped trees, low value species and trees that are crowding better trees should be removed. If each tree is given room to grow throughout its life, all of the trees will increase in volume more rapidly, your woodlands will produce an income sooner, and the land will be producing a maximum volume of forest crops all of the time.

The average number of Douglas-fir trees to keep in the stand varies with the age of the stand and the quality of the growing site. An average number of trees per acre on an average site may be about as follows:

Age of Trees (years)	Approximate Diameter (inches)	Approximate No. of Trees	Average Spacing Between Trees (feet)
10	2 to 4	680	8
20	4 to 8	534	9
30	6 to 12	435	10
40	10 to 16	302	12
50	12 to 20	240	14
60 & over	14+	169 to 90	16 to 22

Check the age and average diameter of the larger trees in your stand and thin to the indicated spacing for a good growth rate. Thinning should be made at about 5-year intervals or at the time the crowns close over previous openings and trees seem to crowd each other.

The tree volumes shown on the next page are those shown in table 25, page 68 of Technical Bulletin #201 "The Yield of Douglas-fir in the Pacific Northwest" by McArdle & Meyer, revised in October 1949, with a supplementary treatment by Don Bruce.

In this treatment, height is more a function of diameter growth than site and age. Volume is shown as a function of average diameter instead of site and age. By frequent thinning to insure fairly even spacing and removal of slow growing trees, the diameter growth rate sought can be obtained for many years. However, assurance cannot be given that growth rates of 4 and 6 rings per inch can be maintained after trees reach the age of 50 years.

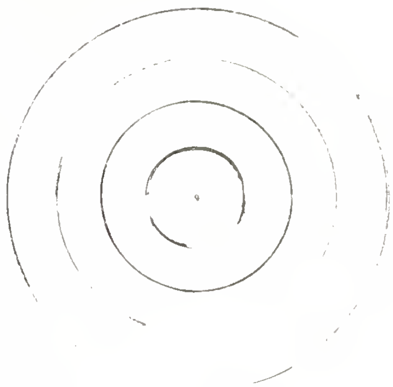
The chart on the following page indicates the results when such growth rates are maintained.

Comparative Volumes and Values of Trees

at 10-Year Intervals with Varied Rates of Growth

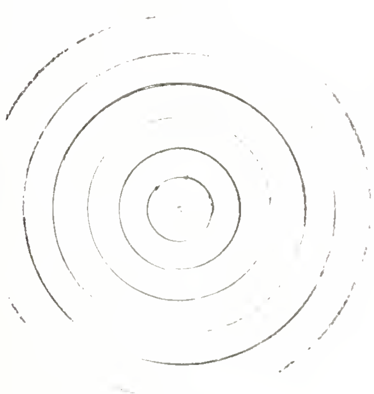
Volumes and heights from table 25, page 68, Technical Bulletin 201, Revised October 1949. Yield based on average diameter.

4 Rings per Inch



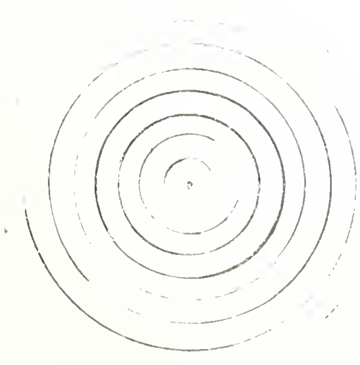
Age of Tree	Inches*: D.B.H.	Total Tree Height (Feet)	Vol. in Bd. Ft.	Tree Value at $20/MBM
10	2		0	0
20	7	62	3	.06
30	12	97	99	1.98
40	17	130	359	7.18
50	22	157	779	15.58

6 Rings per Inch



10	2		0	0
20	5	47	0	0
30	8	69	11	.22
40	11	90	67	1.34
50	15	117	236	4.72
60	18	150	429	8.58

8 Rings per Inch



10	1		0	0
20	4	39	0	0
30	6	55	0	0
40	9	76	23	.46
50	11	90	67	1.34
60	14	110	184	3.68
70	16	123	296	5.92

* It is assumed that all trees took 6 years to reach a 4½' height, so diameter growth at that point starts at age of six years.

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

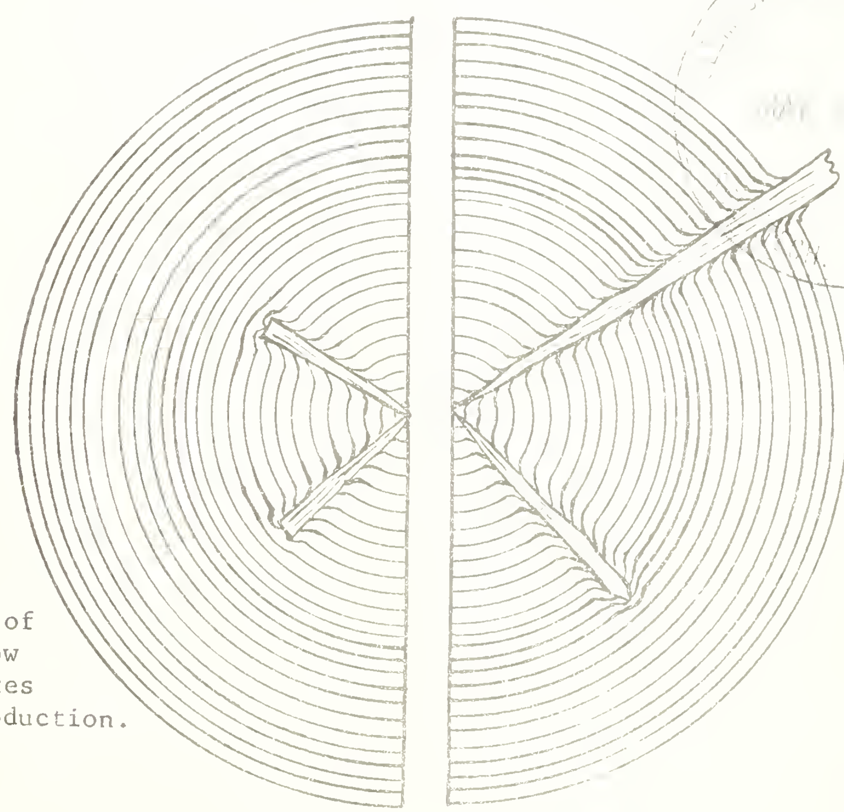
PACIFIC NORTHWEST REGION-STATE AND PRIVATE FORESTRY

No. 3 PORTLAND, OREGON August 1959

PRUNING DOUGLAS-FIR TO INCREASE TIMBER VALUE

Is pruning of Douglas-fir trees worth the effort and cost? How can the owner of a woodland area get an increased financial return to pay back the pruning costs? Should your stand of second growth be pruned and how and when should you do it?

As a tree grows in size and height, the lower branches become shaded by adjoining trees and gradually die. The branches stay on the tree or break off leaving a stub for many years. As the tree continues to grow, wood grows around the stub and eventually will cover over the stub of the branch. Lumber cut from the log will contain knots until these branches are all covered over. This may take from 20 to 40 years after the branch dies. Knots formed by these dead branches are black and become loose resulting



Cross section of log showing how pruning promotes clear wood production.

FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

in knot holes. If the branches stay alive, the knots, though tight, get larger and larger which means lower grades of lumber will be produced from cutting the log.

If a tree is pruned, the stub of the branch is covered over by wood growth in a few years. From then on, the tree will be producing knot-free wood from which clear lumber or veneer can be obtained when the log is cut. Since the mill operator can sell these products at a higher price, he can afford to pay a higher stumpage rate for the logs. This rate will vary, depending on the amount of growth in the clear portion of the log. If the annual rings are only two inches past the ends of the stubs, there will be little increase in log grade value since most of the clear material will be cut off in the slab or in trimming the lumber. As the thickness of the clear growth increases, the percentage of quality material increases and this should be reflected in the stumpage price.

Trees should be pruned at as early an age as possible to start clear growth sooner. Trees over 6" or 8" in diameter are usually considered to be too large for pruning. The branches will be larger and pruning costs will be higher. Also, the tree will not grow a large enough percentage of clear material before harvest age.

Only the better trees in the stand on fairly good sites should be pruned. These trees should be selected because of good form and growth rate and also to allow sufficient spacing for future growth. This is usually at about 20 foot spacing through the area or about 80 to 120 trees per acre. These trees will be the last trees in the stand to be logged. All of the unpruned trees will eventually be cut in thinning operations to promote growth in the pruned trees. In this way, the values to be gained by pruning will be increased. The pruned trees should be permanently marked with a band of paint to prevent accidental cutting before maturity. A record showing the year of pruning and the number of pruned trees should also be kept to justify an increased sale price if the land is sold before the trees reach harvest age.

The best season for pruning is from late summer until early spring while the trees are relatively dormant. The bark is less likely to tear during this period and the subsequent rapid spring growth helps to cover the stubs more quickly.

Pruning can be done with a club or a hand pruning saw for the low dead branches. Pole pruning saws with 8 and 12 foot handles should be used for the higher branches. Goggles are helpful to keep sawdust out of the operator's eyes when cutting the higher branches. All dead branches and stubs should be removed. Green branches can be cut to a point where at least two thirds of the live crown remains on the tree. Cutting too many of the green branches will weaken the tree and slow down the growth rate. It is desirable to prune to a height of 17 feet on each tree to permit cutting a 16-foot log above the stump level. Pruning to a greater height to produce a second clear log is not considered economical at present. Young trees may have to be pruned several times to reach this height without removing too much crown in one operation. Branches should be cut as close to the trunk as possible at the edge of the swelling around the branch. Larger green branches may require undercutting to prevent saw bind or bark tearing when the branch breaks.

If numerous green branches are cut, a concentration of slash accumulates under the tree. These should be scattered away from the tree to prevent

accidental fires from building up extra heat around these highest value trees. The branches will also lie flatter on the ground and decompose more readily.

Pruning of green limbs from the southwest side of the tree that is exposed to direct sun from 2 to 5 p.m. is likely to expose the tree to sunscald. The sun cooks the growing area killing that side of the tree. Cut only one whorl of live branches each year from such exposed trees.

The cost of pruning is primarily a labor cost since the pruning tools are relatively inexpensive. An average of six trees can be pruned per hour of work. Often this work can be done by the owner during a slack season for his other work. The cost per tree will vary with the size of the tree, the size and number of limbs and the wages that are paid. When hiring labor for pruning, it is usually cheaper to pay for the work on the basis of the number of trees pruned rather than by the hours of work. Labor costs can be figured at about 25¢ per tree. Cash expenditure would be very much less if the owner did all of the work himself.

How much will pruning increase the future sale value of your trees? This cannot be definitely answered without a "crystal ball". However, on the basis of present stumpage prices, a 24" diameter log, 16 feet long, would usually be classed as a No. 2 sawlog with a stumpage value of about $20 per MBM. A similar log pruned at an early age could be sold as a No. 3 peeler at a value of about $40 per MBM. Thus the future value of the log would be doubled by 10 or 15 minutes of work while the tree is young. The supply of old trees with clear wood will become more scarce in future years as the virgin timber stands become more limited. Under natural conditions second growth stands will produce very little clear wood. It is probable that pruned logs will bring a much larger income in future years than is possible under present market conditions.

On a good site a stand of pruned trees averaging 24" in diameter and 100 trees to the acre might have a volume of about 100 MBM per acre. Only the butt log of each tree contains extra value material due to the pruning. However, these logs contain the following percentages of the total tree volume depending on the number of 16-foot logs:

3 logs per tree	55%
4 logs per tree	41%
5 logs per tree	32%
6 logs per tree	27%
7 logs per tree	23%

These percentages can be used to determine the increase in stumpage value for an individual tree or for the entire stand. Assuming that the stumpage value of the pruned log is double the value of the unpruned logs, the cash value of the timber would be increased by the above percentages depending on the height of the trees.

Pruning can increase the future value of your young timber stand by improving the quality of the sawlogs. However, the work and investment in pruning will be lost if the timber is not managed to protect and promote growth in the selected trees. Premature cutting of the trees will not produce an increase in stumpage value. A pruned tree is an investment that will only return a profit if the tree is permitted to grow to an optimum size and then is sold as a quality product.

Studies of logs being cut in the sawmill indicate that pruning will be profitable only if the tree is left in the stand long enough to increase at least 6" in radius or 12" in diameter. The actual time to put on this additional diameter or to reach 24" will depend upon the growth rate of the tree. Therefore, all pruned trees should be given release by thinning out competing trees. This will stimulate or maintain a good growth rate of the pruned trees.

# # #

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

PACIFIC NORTHWEST REGION—STATE AND PRIVATE FORESTRY

PORTLAND, OREGON

No. 4

February 1960
Revised April 1961

SELECTING A GOOD AREA FOR GROWING CHRISTMAS TREES IN THE PACIFIC NORTHWEST

THIS LAND CAN PRODUCE GOOD DOUGLAS-FIR CHRISTMAS TREES. NATURAL TREES ARE ABUNDANT, GROWTH IS MODERATE, TREE SHAPE IS SYMMETRICAL AND BUSHY AND LARGER TREES ARE AVAILABLE FOR SEED SOURCE.

THIS LAND IS MUCH BETTER ADAPTED TO GROW SAWTIMBER THAN DOUGLAS-FIR CHRISTMAS TREES. LONG LEADERS AND SPARSE BRANCHES INDICATE RAPID GROWTH. SPINDLY TREES CANNOT COMPETE ON THE MARKET WITH BUSHY TREES.

WHAT TYPE OF CHRISTMAS TREE FARM TO ESTABLISH?

Anyone planning to grow Christmas trees commercially should give careful thought to a proper choice of land, species and type of operation to undertake. Three types of Christmas tree operations are found in the Pacific Northwest. These are described on the next page.

FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

1. Natural Stands Unmanaged for Christmas Tree Production

These stands may produce Christmas trees from thinnings when 8 to 12 years old. Within a few years the trees grow beyond Christmas tree size. The primary purpose of this stand is future timber production. Christmas trees are only an incidental and temporary product. Compared with managed Christmas tree stands, production per acre is low and includes few trees of top quality.

2. Cultured Natural Christmas Tree Stands

Christmas trees may be developed from young natural stands by application of various cultural practices, such as weeding, thinning, pruning, scarring, shearing and stump culture. Details of various cultural practices are explained in other bulletins. Several older trees per acre are usually left to provide a natural seed supply. All other trees are cut when they reach Christmas tree size. Unstocked or poorly stocked spots are sometimes interplanted with seedlings to bring them into full production. Thus a continuous crop of Christmas trees is produced and harvested year after year.

3. Christmas Tree Plantations

These are established by planting seedlings for the purpose of growing Christmas trees. Cleared lands are generally preferred to stump or brush lands. Cultural practices such as pruning, scarring, shearing and stump culture may be applied to plantations the same as to cultured natural stands.

CHRISTMAS TREE PLANTATIONS ARE USUALLY ESTABLISHED ON CLEARED AGRICULTURAL LANDS. SHOWN ABOVE IS A NOBLE FIR PLANTATION. THIS SPECIES GROWS SLOWLY AND MAY BE PLANTED ON BETTER SOILS. FAST GROWERS, SUCH AS DOUGLAS-FIR AND SCOTCH PINE, SHOULD BE PLANTED ON SLOWER TREE-GROWING LANDS TO MAINTAIN A DESIRABLE LEADER GROWTH.

THIS CULTURED NATURAL CHRISTMAS TREE STAND HAS HAD BRUSH, HARDWOODS AND SURPLUS TREES REMOVED TO PROVIDE PLENTY OF GROWING SPACE. LOWER LIMBS HAVE BEEN PRUNED TO IMPROVE QUALITY AND PERMIT SUNLIGHT TO REACH THE SMALLER TREES NEAR THE GROUND.

Unmanaged natural stands, the first type described, are less productive and profitable than managed stands for growing Christmas trees. The decision usually lies between establishing either a cultured natural stand or a plantation. The following comparisons are made to help the grower decide which type is most practical and profitable for him.

Comparative Advantages

Cultured Natural Stands

1. Lower land costs.
2. Elimination or reduction of planting costs.
3. Shorter time before harvesting begins.

Plantations

1. Control over species of trees.
2. Better spacing.
3. Less brush and hardwood competition.
4. Usually less fire risk.

Comparative Production Statistics for Pacific Northwest in 1959

	Wash.	Ore.	PNW Total
Natural stands*	46%	89%	57%
Cultured natural stands	54%	9%	42%
Plantations	1% -	2%	1%
Number of trees cut	2,610,000	940,000	3,550,000

*Although natural unmanaged stands still provide the greatest number of Christmas trees in the Northwest, the demand is dropping off each year. The growing demand for cultured natural and plantation trees reflects the buyers' preference for higher quality trees.

ESTIMATED COSTS AND RETURNS FROM GROWING CHRISTMAS TREES

The tabulation on page 5 represents a hypothetical comparison of production costs and expected returns from two types of Douglas-fir Christmas tree farms--cultured natural and plantations. This table compares the production and interest costs to grow a crop of Christmas trees in a ten-year period. On plantations we assume that there would be no income from the areas during the ten years and all of the trees would be harvested at the end of the ten-year period. On natural areas, part of the crop would be harvested during each of the ten years.

A lower purchase price is assumed for natural stocked areas since they are usually developed on cutover timber lands, while plantations are usually established on more valuable cleared agricultural lands. The natural areas are assumed to be stocked with an adequate number of trees so there is no planting cost. However, production of more trees per acre is assumed for the plantations since growing space is lost on natural areas due to the presence of seed trees, stumps, debris and unstocked spots. Protection costs are higher on natural areas due to greater amounts of flammable debris and usually more problems from livestock, deer and rodents. Higher stumpage values are allowed for plantation-grown trees because of lower anticipated harvesting costs.

A rate of 6% compound interest was assumed for all costs, including labor, for the period of investment. This represents a reasonable rate for invested capital whether the money is borrowed or the landowner's own savings are invested in the operation. Since the land can be sold at a future date, the land purchase price was not charged as a cost against the Christmas tree enterprise. However, the interest on the land cost was charged as a production cost.

It should be emphasized that most of the production costs are for labor. Most Christmas tree growers would probably do this work themselves and consider the savings in costs as simply a part of their earnings in addition to profits. If it is assumed that the cost of labor is two-thirds of the production expense, then the grower could earn an additional $152.70 per acre in 10 years on the cultured natural area and $252 per acre on the plantation. Also, many growers would harvest their own trees rather than sell them on the stump. In this way, they could earn an additional 20 to 30 cents per tree or from about $200 to $300 per acre.

The analysis for both areas indicates that growing high-quality Christmas trees under intensive management can yield attractive rates of return over the relatively short investment period of ten years. Although the plantation shows a higher net income per acre than the cultured natural operation, it requires a greater capital investment.

Producing a crop of Christmas trees is only part of the job. In order to realize satisfactory investment returns, considerable business skill and experience is also necessary. Except in the South Puget Sound area, there are very few organized marketing channels for Christmas trees. In other areas, each grower must make his own contacts and arrangements for selling his trees. Successful marketing may make the difference between success and failure for the entire operation.

COMPARATIVE ANALYSIS
FOR TWO TYPES OF CHRISTMAS TREE OPERATIONS

	Cost or Value per Acre	
A. Production Costs	**Cultured Natural**	**Plantation**
Land investment - - - - - - - - - - - - - -	$ 60.00	$ 150.00
Taxes for 10 yrs. (assumed as 1% of land value per yr.) - - - - - - - - - - - -	6.00	15.00
Initial treatment of natural stand - -	35.00	--
Planting, including ground preparation (1,500 seedlings and 200 replants) -	--	65.00
Annual culture, including shearing, for 9 years ($12/yr.) - - - - - - - - - - -	108.00	108.00
Mowing and land cultivation for 10 yrs.	--	150.00
Protection against fire, trespass, rodents, insects, disease, livestock and game, ($8 and $4 annually for 10 yrs.) - -	80.00	40.00
Total investment	289.00	528.00
Less land value	-60.00	-150.00
Total	$ 229.00	$ 378.00
B. Imputed Interest Charges at 6%		
On land investment - - - - - - - - - - -	47.50	119.70
On taxes - - - - - - - - - - - - - - - - - -	1.90	4.80
On initial planting or treatment costs	27.70	51.40
On annual cultural costs - - - - - - - -	29.90	29.90
On plantation mowing and land cultivation costs - - - - - - - - - - - - - - - - - - -	--	47.70
On protection expenditures - - - - - - -	25.40	12.70
Total	$ 132.40	$ 266.20
Total cost including interest (A/B) - -	$ 361.40	$ 644.20
C. Returns		
Stumpage value:		
(1) 1,000 trees at average of $.80/tree	800.00	
(2) 1,300 " " " " $.90/tree		1,170.00
Production costs - - - - - - - - - - - - -	-229.00	- 378.00
Net cash returns, before taxes - - - -	571.00	792.00
Imputed interest, at 6% - - - - - - - - -	132.40	266.20
Net income for 10 years before taxes -	438.60	525.80
Average net income per year, before taxes	43.86	52.58

While the above figures are based on the best available estimates of costs and values, they are hypothetical examples and should not be considered or used as representative of any forest property. This table was prepared to show one simple method of making an economic analysis.

GENERAL CONSIDERATIONS

The safest bet is to acquire land in general areas where others have successfully grown Christmas trees. The local forester can be of valuable assistance in making a good selection.

Protection from livestock, deer, rodents, insects, disease and fire are important considerations. Necessary remedies may include fencing, rodent control, spraying, insecticides, ground preparation, snag falling and firebreaks. In some cases, particularly for cultured natural Christmas tree stands, protection costs may exceed the cost of the land. In any event, a wise buyer considers necessary protection as well as cultural costs when comparing land values.

The ideal location for a Christmas tree farm is on your home property where it can be conveniently protected and worked. Where this is not not possible, it is desirable to establish the Christmas tree farm within working distance from home. Trespass problems can be reduced by selecting an area with controlled access, such as a private or gated road. Trespass signing and patrolling the area during the harvesting season may be necessary precautions. If a "choose-and-cut" operation is contemplated, it should be located reasonably close to population centers. It should also be provided with adequate roads, trails and parking space for customers.

Good access to the Christmas tree farm is a necessity. The finest producing area has little value without public road access or adequate right-of-way across private lands. Roads made impassable by mud or snow during the harvesting season present a similar problem.

Gently sloping or level lands have several advantages over steep ground. They are less susceptible to fire and erosion problems and are more easily worked by men and equipment. Construction and maintenance costs for roads and trails are relatively high on steep slopes.

Favorable location with respect to markets is important. Types of marketing outlets and distance to rail shipping points, concentration yards and retail outlets need careful study. Growers in established Christmas tree growing areas are in a better position to establish buyer contacts than those in isolated locations. Membership in a Christmas tree association will provide opportunities to meet other growers and dealers and to keep informed about new methods and procedures.

CONSIDERATIONS WHEN SELECTING LAND FOR CULTURED NATURAL CHRISTMAS TREES

Areas which are well stocked with natural trees of good Christmas tree quality are somewhat limited. Some considerations when looking for such areas are:

1. Areas with species which are in good market demand. Be certain that the area is well stocked with the proper Christmas tree species. The following tabulation indicates the production by species, in percent, for the 1959 Christmas season:

Oregon	Western	Eastern
Total Trees	630,000	310,000
Douglas-fir	77%	22%
Grand & concolor	11%	68%
Noble & Shasta red	6%	5%
Lodgepole & shore pines	5%	4%
Others	1%	1%
	100%	100%

Washington

Total Trees	2,360,000	250,000
Douglas-fir	96%	82%
Grand fir	1%	16%
Noble & silver	1%	-
Lodgepole pine	1%	1%
White pine	1%	-
Others	-	1%
	100%	100%

A person would not select an area which is stocked with western hemlock, Sitka spruce or western red cedar since the demand is very limited. Western hemlock and Sitka spruce, for example, have poor needle retention, while western red cedar is of limited acceptance as a Christmas tree.

2. Well stocked with young trees. The ideal size is from 2 to 8 feet in height. Proper spacing between trees, about 5 feet by 5 feet, may be adjusted later by thinning.

3. Consider the growth rate. Pay particular attention to natural trees which are now of Christmas tree height. Ideal growth rate is about 12 to 16 inches per year. This can be determined by measuring the length of the leader and the distance between branch whorls. Also notice tree fullness, branch stiffness, length and color of needles, freedom from disease and overall tree shape.

Good timber growing lands, which are evidenced by long leaders and sparse branching, should grow forest products other than Christmas trees. On the other hand, very poor timber growing lands, evidenced by spindly trees with weak limbs, thinly needled and of poor color, should be avoided.

4. Reasonably free of competing vegetation. Brush, hardwoods, unwanted conifers and tall weeds compete with Christmas trees for space, moisture and sunlight. Control measures for eliminating unwanted species may exceed $35 per acre. Follow-up treatment is often necessary.

5. Check the fire hazard. Natural Christmas tree areas should be relatively free of snags, down logs, and flashy fuels such as slash. Snag falling, piling and burning of slash etc. are additional costs which should not be overlooked. Consider the hazards on adjoining properties and chances of fire from nearby centers of activity. A system of roads to all parts of the area is essential for moving in fire equipment quickly. It also serves as a firebreak and access for culturing and harvesting the Christmas trees.

CONSIDERATIONS WHEN SELECTING LAND FOR A CHRISTMAS TREE PLANTATION

Plantations are quite common throughout western Oregon and Washington. To a lesser extent, they have also been established east of the Cascade summit in areas where the natural moisture condition or irrigation permits tree growing.

Although Christmas tree plantations have been established for a number of years in the Eastern and Central States, they are relatively new in the Pacific Northwest. Most plantations have been established in the past 5 years. Seven to 12 years is usually required for planted nursery seedlings to grow to commercial Christmas tree size.

Favored sites for Christmas tree plantations are well-drained, cleared lands recently abandoned from cultivation. Old fields containing heavy sod or weed growth may also be planted, but the ground must first be properly prepared. This may be accomplished by summer fallowing or plowing and

planting to a light cover crop the year previous to tree planting.

Partially cleared lands are less desirable than completely cleared lands. Stumps, logs, debris and brush obstruct planting, cultivating and mowing. Some areas are unsuitable for plantations whether cleared or not. These include lands subject to flood, earth slides, erosion or poor drainage. It also includes land on which equipment cannot operate efficiently due to steep slope, shallow bedrock or numerous loose boulders. Proper air drainage is also important. Low spots or dips commonly referred to as "frost pockets" should be avoided.

Matching a planting area to the best adapted species is perhaps the most difficult decision for the Christmas tree grower. If he already owns land, he must first decide if his land is suitable for growing any kind of Christmas trees. If it is suitable, he must then decide what species will grow well on the land and be in demand at harvest time.

If the grower plans to purchase land, he has a great deal more latitude for decision. He should first decide what species are profitable, and secondly, the type of land that is best suited.

The growth rate comparisons shown below are intended only as a general guide for planting on lower elevations west of the Cascades. Growth rates of each species will vary according to how well it is naturally adapted to the particular site on which it is planted. As an example, spruces tolerate moist, poorly drained sites better than pines and pines tolerate dry, exposed sites better than spruces. Also, the species shown as slow growers at lower elevations are not necessarily slow growing in their natural habitat.

Most growers prefer to plant fast-growing species on poorer, drier soils and slow-growing species on better, moister soils. If they desire to plant several different species, their safest choice is a compromise between the 2 extremes. A few growers prefer to plant fast-growing species on better agricultural lands, but they must control excessive growth by severe and frequent shearing.

Only trial and error will give the final answer as to which species will be best adapted to any planting site. However, the following procedures will help the grower make a decision.

1. Talk with experienced Christmas tree growers who own plantations where growing conditions are similar. Observe the growth rate and shape of various species in their plantations.

2. Consult with the local forester. If possible, go over the ground with him.

Rapid	Moderate	Slow
Douglas-fir	Grand fir (Abies grandis)	Noble fir
Scotch pine	White fir (Abies concolor)	Shasta red fir
Ponderosa pine	Norway spruce	Alpine fir
Lodgepole pine	Austrian pine	Silver fir
(Coast & interior)		Colorado blue spruce

3. Consider the relative advantages and disadvantages of lands that produce fast tree growth versus lands that produce slow tree growth. These are summarized below.

Type of Land	Advantages	Disadvantages
Lands Producing Fast Growth Characterized by one or more of the following conditions: a. Adequate moisture for fast growth. b. Deep, well-drained soils. c. Not exposed to severe climatic influences such as: dry exposures, severe winds and frost pockets. d. Usually good agricultural lands.	1. Slow-growing species produce an adequate rate of growth. 2. Needles have heavy density and good color. 3. Damage and mortality from drought is relatively light. 4. Soil usually tills well.	1. Fast-growing species produce an excessive rate of growth. 2. Trees are costly to ship due to heavy branches and stems. 3. Intensive shearing and other cultural practices are required. 4. Rank growth of grass and weeds competes with the trees and furnishes a habitat for rodents. 5. Land costs are high.
Lands Producing Slow Growth Characterized by one or more of the following conditions: a. Insufficient moisture for fast growth, especially during the critical summer months. b. Shallow or poorly drained soils. c. Exposed to severe climatic influences such as: dry exposures, severe winds and frost pockets. d. Usually poor agricultural lands.	1. Growth of fast-growing species is sufficiently retarded. 2. Trees are easy to ship due to light branches and stems. 3. Minimum shearing and other cultural practices are needed. 4. Grass and weed competition is comparatively light. 5. Land costs are low.	1. Slow-growing species grow too slowly. Longer rotations are required to produce trees of marketable size. 2. Lighter density trees are produced that sometimes lack vigor and good color. 3. Damage and mortality from drought is relatively high. 4. Soil is sometimes difficult to till.
Lands Producing Intermediate Growth	This type of land lies between the two extremes. It is suitable for the widest range of species. However, fast growing species may require intensive pruning and shearing to control excessive growth, and slow growing species may not grow quite as fast as desired.	

DETERMINATION OF SIZE OF CHRISTMAS TREE FARM TO ESTABLISH

Some growers operate large Christmas tree areas as a full-time business. More often Christmas tree growing is a part-time occupation for farmers and other woodland owners from various walks of life. Three or 4 years is normally required to bring a cultured natural stand into full scale production. Even longer--about 7 to 12 years--is required to grow planted seedlings to Christmas tree size. Inexperienced growers should, therefore, feel their way gradually into the business and retain their regular sources of income. In order to gross $8,000 annually from land that can produce 100 trees per acre per year valued at $1 each, a grower would need to have 80 acres in continuous production. Needless to say, keeping this much land in full production with top quality cultured trees requires a great deal of hard work, know-how and investment. It also involves a risk from fire, disease and other hazards.

Eighty acres is about as large an acreage of cultured natural trees as one man can culture and intensively manage without hiring help, except during the cutting season. Growers of plantation Christmas trees should normally plan to work smaller areas than growers of cultured natural Christmas trees. Plantations usually produce more trees per acre and require additional work such as cultivating and mowing to control grass and weeds. Growers who plan to grow Christmas trees on a part-time or week-end basis should develop proportionately smaller areas than full-time growers.

SOURCES OF INFORMATION AND ASSISTANCE

Reference material is available from the County Extension Agent. He can also advise growers concerning the availability of assistance from farm foresters, Extension foresters, soil technicians or others who can evaluate the suitability of lands for growing various species of Christmas trees.

Services of a farm forester are available to most woodland areas in Oregon and Washington. The office address of the local farm forester can be obtained by inquiring at any State District Warden's office in Oregon or State Department of Natural Resources Office in Washington.

Additional sources of information on selection of lands for growing Christmas trees are:

Local offices of the Soil Conservation Service

U.S. Forest Service, P.O.Box 4137, Portland 8, Oregon

Northwest Christmas Tree Association. The name and address of the current secretary may be obtained by contacting a farm forester or writing to the U. S. Forest Service at the above address.

SUMMING UP

The production of good quality Christmas trees is a business that requires a great deal of know-how and hard work. Even then, it can succeed only on land capable of producing quality trees.

The first decision a grower must make is whether to culture a natural stand of small trees or establish a plantation. His second decision is what species of Christmas trees to grow. Finally, he must select an area that is suitable for the chosen type of operation. Important considerations are site topography, existing vegetation, accessibility, markets, required acreage, nearness to home and problems of fire protection, disease, insects and trespass.

It will pay the grower to consult many sources for Christmas tree information before selecting his land. He should obtain advice from a forester, visit a number of successful Christmas tree farms and obtain available literature.

Acknowledgment is made to the following for their guidance and assistance in compiling this information:

Oregon State Board of Forestry.
State of Washington Department of Natural Resources.
Oregon State Extension Service.
Washington State Extension Service.
U. S. Soil Conservation Service.
Forestry Faculty -
Oregon State University,
University of Washington and
Washington State University
Members of the Northwest Christmas Tree Association.

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

PACIFIC NORTHWEST REGION—STATE AND PRIVATE FORESTRY

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SELECTING AN AREA FOR GROWING CHRISTMAS TREES IN THE PACIFIC NORTHWEST

CONTENTS — Page

Prepared by Bernard S. Douglass, U.S. Forest Service (Div. of S&PF) with guidance and assistance of: Oregon State Board of Forestry; State of Wash. Dept. of Nat. Res.; Oregon & Wash. Extension Services; U. S. Soil Conservation Service; Forest School faculties of O.S.U.; U. of W. and W.S.U.; and member growers Northwest Christmas Tree Assn.

FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

SELECTING AN AREA FOR GROWING CHRISTMAS TREES IN THE PACIFIC NORTHWEST

A. INTRODUCTION

The production of good quality Christmas trees is a business that requires a great deal of know-how and hard work. Even then, it can succeed only on land capable of producing quality trees.

Low-grade Christmas trees, such as this one, cannot compete on today's market. Improper site selection and neglect of cultural practices can cause poor quality.

The first decision a grower must make is whether to culture a natural stand of small trees or establish a plantation. His second decision is what species of Christmas trees to grow. Finally, he must select an area that is suitable for the chosen type of operation. Important considerations are site, topography, existing vegetation, accessibility, markets, required acreage, nearness to home and problems of fire protection, disease, insects and trespass. This publication describes some important factors to consider when selecting a Christmas tree growing area.

B. NATURALLY STOCKED LAND OR A PLANTATION?

1. Natural Stands. Many Christmas trees are still produced on unmanaged lands where young trees develop naturally. After 8 to 12 years, a small percentage of the trees have sufficient natural quality to be merchantable. The remaining trees soon grow past Christmas tree size, and will become a future timber crop. Christmas trees are only an incidental and temporary product, production per acre is low and few top quality trees are produced. New harvest areas must be found every few years for a continuous supply of trees.

This natural stand, with management, could produce high quality Christmas trees. Culturing would increase both yield and quality and would also provide a continuous crop.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
PACIFIC NORTHWEST REGION
POST OFFICE BOX 3623
PORTLAND, OREGON 97208

IN REPLY REFER TO

1630

July 1, 1965

We are sending you a revised copy (or copies) of Managing Your Woodland--How to Do It Guide No. 4, "Selecting a Good Area for Growing Christmas Trees in the Pacific Northwest". We gave this pamphlet a new look as well as updating the material.

Additional copies are available in the Division of State & Private Forestry.

Sincerely yours,

E. H. Marshall

E. H. MARSHALL
Assistant Regional Forester

1905-1965

atural stands can be managed to produce continuous crop of Christmas trees rom the area. These are called Cultural Natural" Christmas tree farms. ndesirable trees are cut and the remaining trees are thinned out to provide ood spacing. Several older trees per cre are usually left as a seed source or future trees. The remaining young rees are developed into quality hristmas trees through various cultural practices such as brush control, runing, scarring, shearing and stump ulture. Seedlings may be planted in penings or poorly stocked spots to tilize all of the area and to produce ther desired species. Selected trees re harvested each year and are replaced by new seedlings. Production ontinues year after year.

This cultured natural Christmas tree stand has had brush, hardwoods and surplus trees removed to provide adequate growing space. Lower limbs have been pruned to improve quality and permit sunlight to reach the smaller trees near the ground.

2. Plantations. Suitable lands may be developed for Christmas trees with planted seedlings. Cleared lands are preferable to stump or brush lands. Cultural practices such as pruning, scarring, shearing, and stump culture are applied to plantation trees the same as to natural stands. Seven to 12 years is usually required for planted nursery seedlings to grow to commercial Christmas tree size. Although investment costs are usually higher, plantations sometimes have advantages that make them more desirable than a natural stocked area.

3. Comparative Advantages

Cultured Natural Stands

1. Lower land costs.
2. Elimination of planting costs.
3. More immediate harvesting.

Plantations

1. Control over species.
2. Better spacing.
3. Less brush and hardwoods.
4. Lower fire risk.

This noble fir was established on cleared agricultural land. On lowland areas, plantations of noble and other true firs develop best on faster growing sites. These sites are usually found on level to gentle northerly or easterly exposures where soil is moderately moist and fertile.

ECONOMIC ANALYSIS

FOR TWO TYPES OF CHRISTMAS TREE OPERATIONS

A. Production Costs	Cultured Natural	Plantation
1. Land investment - - - - - - - - - - - - - - - -	$ 80.00	$ 200.00
2. Taxes for 8 years (assumed as 1% of land value per year) - - - - - - - - - - - - - - -	6.40	16.00
3. Initial treatment of natural stand - - - -	35.00	-
4. Planting, including ground preparations (1,500 seedlings and 200 replants) - - - -	-	75.00
5. Annual culture for:		
a. Cultured natural (8 yrs @ $15/yr)	120.00	-
b. Plantation (6 yrs @ $20/yr) - - - -	-	120.00
6. Grass, and weed control; cultivating, chemicals, and mowing (8 yrs @ $20/yr) - -	-	160.00
7. Protection against fire, trespass, rodents, insects, disease, livestock and game (8 yrs @ $8/yr) - - - - - - - - - - - - - -	64.00	64.00
Total investment	$ 305.40	$ 635.00
Less land value	-80.00	-200.00
	$ 225.40	$ 435.00
B. Compounded Interest Charges at 6%		
1. On land investment - - - - - - - - - - - - - -	$ 47.52	$ 118.80
2. On taxes -	1.99	4.98
3. On initial planting or treatment costs - -	20.79	44.55
4. On annual cultural costs- - - - - - - - - - - -	37.37	27.88
5. On grass and weed control - - - - - - - - - -	-	49.84
6. On protection costs - - - - - - - - - - - - - -	19.93	19.93
Total Interest	$ 127.60	$ 265.98
Total costs including interest	$ 353.00	$ 700.98
C. Returns		
Stumpage value:		
a. 100 trees per year for 8 yrs at average of $1/tree - - - - - - - - -	$ 800.00	-
b. Compound interest at 6% on above returns to 8th year - - - - - - - -	249.10	-
c. 1300 trees (cut at age eight) at average of $1.25/tree - - - - - - -	-	$ 1,625.0
Total Returns - - - - - - -	$1,049.10	
Less production costs including interest	-353.00	-700.9
Net Income for 8 years - -	$ 696.10	$ 924.0
Average Net Income Per Year, before taxes	87.01	115.5

While the above figures are based on the best available estimates of costs and values, they are hypothetical examples and should not be used as representing any particular forest property. This table was prepared to show one method of making an economic analysis.

Comparative Analysis of Costs and Returns

The tabulation on page 4 represents a hypothetical comparison of production costs and expected returns from two types of Douglas-fir Christmas tree farms--cultured natural and plantations. This table compares the production and interest costs to grow a crop of Christmas trees in an eight-year period. On plantations we assume that there would be no income from the areas during the eight years and all of the trees would be harvested at the end of the eight-year period. On natural areas, part of the crop would be harvested during each of the eight years.

A lower purchase price is assumed for natural stocked areas since they are usually developed on cutover timber lands, while plantations are usually established on more valuable cleared agricultural lands. The natural areas are assumed to be stocked with an adequate number of trees so there is no planting cost. However, production of more trees per acre is assumed for the plantations since growing space is lost on natural areas due to the presence of seed trees, stumps, debris and unstocked spots. Higher stumpage values are allowed for plantation-grown trees because of lower anticipated harvesting costs.

A rate of 6% compound interest was assumed for all costs, including labor, for the period of investment. This represents a reasonable rate for invested capital whether the money is borrowed or the landowner's own savings are invested in the operation. Since the land can be sold at a future date, the land purchase price was not charged as a cost against the Christmas tree enterprise. However, the interest on the land cost was charged as a production cost.

It should be emphasized that most of the production costs are for labor. Most Christmas tree growers would probably do this work themselves and consider the savings in costs as simply a part of their earnings in addition to profits. Also, many growers would harvest their own trees rather than sell them on the stump. In this way, they could earn an additional 20 to 30 cents per tree or $200 to $300 per acre.

The analysis for both areas indicates that growing high-quality Christmas trees under intensive management can yield attractive rates of return over the relatively short investment period of eight years. Although the plantation shows a higher net income per acre than the cultured natural operation, it requires a greater capital investment.

Producing a crop of Christmas trees is only part of the job. In order to realize satisfactory investment returns, considerable business skill and experience is also necessary. Except in the South Puget Sound Area, there are very few organized marketing channels for Christmas trees. In other areas, each grower must make his own contacts and arrangements for selling his trees. Successful marketing may make the difference between success and failure for the entire operation.

C. SIZE OF CHRISTMAS TREE FARM

Some growers operate large Christmas tree areas as a full-time business. More often Christmas tree growing is a part-time occupation for farmers and other woodland owners from various walks of life. Three or four years is normally required to bring a cultured natural stand into full scale production. Even longer--about 7 to 12 years--is required to grow planted seedlings to Christmas tree size.

Inexperienced growers should, therefore, feel their way gradually into the business and retain their regular sources of income. In order to gross $8,000 annually from land that can produce 100 trees per acre per year valued at $1 each, a grower would need to have 80 acres in continuous production. Needless to say, keeping this much land in full production with top quality cultured trees requires a great deal of hard work, know-how and investment. It also involves a risk from fire, disease and other hazards.

Eighty acres is about as large an acreage of cultured natural trees as one man can culture and intensively manage without hiring help. Growers of plantation Christmas trees should normally plan to work smaller areas than growers of cultured natural Christmas trees. Plantations usually produce more trees per acre and require additional work such as cultivating and mowing to control grass and weeds. Growers who plan to grow Christmas trees on a part-time or weekend basis should develop proportionately smaller areas than full-time growers.

D. LOCATION CONSIDERATIONS

1. Site. Land should be naturally suitable for Christmas tree production. Excessively rapid growth or very slow growth is undesirable. The safest selection would be land in general areas where others have successfully grown Christmas trees.

2. Accessibility for Managing the Area. The ideal location for a Christmas tree farm is on your home property where it can be conveniently protected and worked. Where this is not possible, it is desirable to establish the Christmas tree farm within working distance from home. Trespass problems can be reduced by selecting an area with controlled access, such as a private or gated road. Signing and patrolling against trespass during the harvesting season may be necessary.

3. Accessibility for Harvesting. Good access to the Christmas tree far is a necessity. The finest producing area has little value without public road access or adequate right-of-way across private lands. Roads made impassable by mud or snow during the harvesting season present a similar problem. If a "choose-and-cut" operation is contemplated, it should be reasonably close to population centers. It should also be provided with adequate roads, trails, and parking space for visitors.

4. Protection Problems. Trees need protection from livestock, deer, rodents, insects, disease, and fire to insure survival and prevent damage that will reduce quality. Necessary remedies may include fencing, rodent control, spraying, insecticides, ground preparation, snag falling and firebreaks. In some cases, particularly for cultured natural Christmas tree stands, protection costs may exceed the cost of the land.

A wise buyer considers necessary protection as well as cultural costs whe comparing land values.

5. Topography. Gently sloping o level lands have several advantages over steep ground. They are less susceptible to fire and erosion and are more easily worked by men and equipment. Construction and maintenance costs for roads and trails are relatively high on steep slopes.

6. Accessibility to Markets. Favorable location with respect to markets is important. Types of marketing outlets and distance to rail shipping points, concentration yards and retail outlets need careful study. Growers in established Christmas tree growing areas are in a better positio to establish buyer contacts than thos in isolated locations.

mbership in a Christmas tree association will provide opportunities to et other growers and dealers and to ep informed about new methods and ocedures.

SELECTION OF A SUITABLE NATURAL STAND

e following items should be consider- when looking for a natural stand itable for culturing Christmas trees:

1. Is the Area Well-stocked with ecies for which There Is A Good rket Demand? Douglas-fir leads in mber of Christmas trees harvested this region. There is also a good mand for noble fir, grand fir, conlor fir, silver fir, lodgepole pine, d shore pine. White pine and pondera pine are used in limited quantities. area stocked with Sitka spruce, stern hemlock or western red cedar uld not be selected since the demand r them is very limited. Usually ese are classed as weed trees by ristmas tree growers and would be opped out to make room for more luable species. A few seed producg trees are also desirable on the ea to provide for restocking.

2. Is the Area Stocked with edominately Small-sized Trees? e ideal size is from 2 to 8 feet in ight. This permits some immediate rvest and starting of cultural actices to develop the remaining ees. Proper spacing, about 5 feet 5 feet, can be obtained later by inning or, if necessary, by planting.

3. Is the Area Producing an equate Natural Growth Rate? y particular attention to growth bits of natural trees which are now Christmas tree height. Ideal owth rate for unsheared trees is out 12 to 16 inches per year. This n be determined by measuring the ngth of the leader and the distance tween branch whorls. Also notice e fullness, branch stiffness, length d color of needles, freedom from sease and overall tree shape.

Lands that produce quite rapid tree growth, as evidenced by long leaders and sparse branches are usually better suited to grow timber than Christmas trees. On the other hand, very poor timber growing lands as evidenced by extremely retarded growth, limbs, sparse needles and poor color, are unlikely to produce many high quality Christmas trees.

4. Is the Area Reasonably Free of Competing Vegetation? Brush, hardwoods, and undesirable conifers compete with Christmas trees for space, moisture and sunlight. Control measures for eliminating unwanted species is expensive and often requires follow-up treatment to kill sprouts.

Tall ferns and weeds, usually found on lands that produce rapid tree growth, are also undesirable. They suppress growth of small seedlings. They also force the grower to extend basal pruning high enough to keep the lower whorls above the level of heavy shade.

Production of Christmas trees here would be costly. Competing brush and hardwood trees must be removed by chemical spraying, bulldozer scarification, or hand labor. Annual treatment would be needed to control sprouts or new growth.

CHARACTERISTICS OF VARIOUS SITES

Type of Land	Advantages	Disadvantages
Land Producing Fast-Growth Characterized by one or more of the following conditions: a. Adequate moisture for fast growth. b. Deep, well-drained soils. c. Not exposed to severe climatic influences such as: dry exposures, severe winds and frost pockets. d. Usually good agricultural lands.	1. Slow-growing species produce an adequate rate of growth. 2. Needles have heavy density and good color. 3. Damage and mortality from drought is relatively light. 4. Soil usually tills well 5. Trees respond quickly to shearing and leader pruning.	1. Fast-growing specie produce an excessiv rate of growth. 2. Trees are costly to ship due to heavy branches and stems. 3. Intensive shearing and other cultural practices are required. 4. Rank growth of gras and weeds competes with the trees and furnishes a habitat for rodents. 5. Land costs are high
Lands Producing Slow-Growth Characterized by one or more of the following conditions: a. Insufficient moisture for fast growth, especially during the critical summer months. b. Shallow or poorly drained soils. c. Exposed to severe climatic influences such as: dry exposures severe winds and frost pockets. d. Usually poor agricultural lands	1. Growth of fast-growing species is sufficiently retarded. 2. Trees are easy to ship due to light branches and stems. 3. Minimum shearing and other cultural practices are needed 4. Grass and weed competition is comparatively light. 5. Land costs are low.	1. Slow-growing speci grow too slowly. Longer rotations a required to produc trees of marketabl size. 2. Lighter density tr are produced that sometimes lack vig and good color. 3. Damage and mortali from drought is relatively high. 4. Soil is sometimes difficult to till. 5. Trees respond too slowly for shearir
Lands Producing Intermediate Growth	This type of land lies between the two extremes. It is suitable for the widest range of species. However, fast-growing species may require intensive pruning and shearing to control excessive growth, and slow-growing species may not grow quite as fast as desired.	

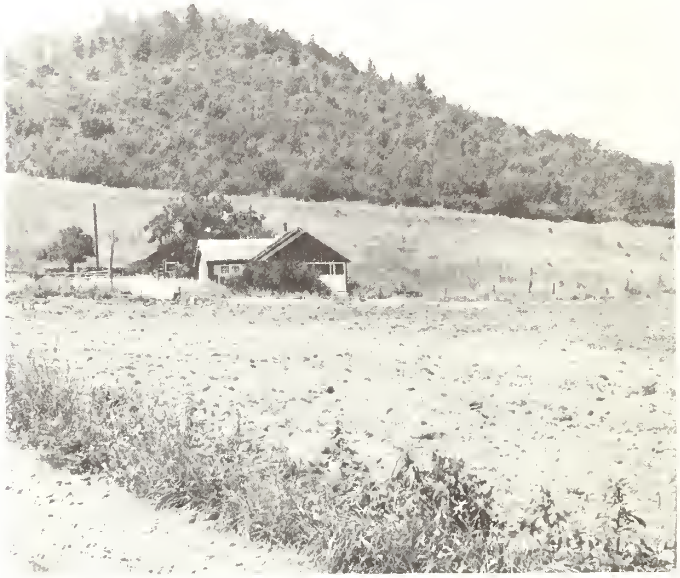
5. Is the Area Free from Serious re Hazards? Natural Christmas tree eas should be kept relatively free om snags, down logs and flashy fuels ch as slash. Snag falling, piling d burning of slash, and fire trail- g are additional costs which should t be overlooked. Consider the zards on adjoining properties and ances of fire from nearby centers of tivity. An existing system of roads all parts of the area is a definite set.

SELECTION OF A SUITABLE PLANTATION AREA

though Christmas tree plantations ve been established for many years in e Eastern and Central States, most antations in the Pacific Northwest ve been planted in the past 10 years. ey are quite common throughout estern Oregon and Washington. To a sser extent, they have been estab- shed east of the Cascade Summit in eas where the natural moisture con- tion or irrigation permits tree owth.

1. Cleared Versus Uncleared Lands. vored sites for plantations are well- ained cleared lands with low to moder- e fertility which have recently been andoned from cultivation. Old fields ntaining heavy sod or weed growth may so be planted but the ground must first properly prepared. This may be accom- ished by summer fallowing or plowing d planting to a light cover crop for e season previous to tree planting. rtially cleared lands such as unde- loped pasture areas or nonstocked gging areas are less desirable. umps, logs, debris and brush obstruct chine operation for planting, culti- ting and mowing. Such areas usually ve the disadvantages of natural re- ocked lands and have the added pense of hand planting.

me areas are unsuitable for planta- ons whether cleared or not. These clude lands subject to flood, earth ides, erosion or poor drainage. It so includes land on which equipment cannot operate efficiently due to steep slope, shallow bedrock or numerous loose boulders. Proper air drainage is also important. Low spots or dips commonly referred to as "frost pockets" should be avoided.



Foothill agricultural lands of low-fertility are often suitable for Christmas tree plantations.

2. Adaptability of the Area to the Desired Species. Growth rates of each species of trees will vary depending on growing conditions of the site on which it is planted. As an example, spruces, shore pine, and grand fir are relatively tolerant of moist poorly drained soils. Pines are more tolerant than other species on infertile shallow soils and severe south and west exposures. True firs, such as noble, Shasta, grand and concolor prefer deep moist soils on north and east exposures. Species such as noble fir and Shasta fir that grow slowly when planted in low elevation plantations are not necessarily slow-growing in their higher natural habitat. Choice of species for arid eastside plantations is limited to relatively few drought-resistant species such as lodgepole pine, Scotch pire, and Austrian pine.

Matching the best adapted species to a plantation area is perhaps the most

difficult decision for the Christmas tree grower. He must decide which species will grow at desirable rates, which species will be in demand at harvest time, and which species will bring the most profit. Since seedlings inherit growth characteristics that vary with seed source, this factor also needs to be considered.

The growth rate comparisons shown below are intended as a general guide for plantings at lower elevations west of the Cascades.

Rapid Growth Rates
- Douglas-fir
- Scotch pine
- Ponderosa pine
- shore pine

Moderate Growth Rates
- Grand fir (Abies grandis)
- White fir (Abies concolor)
- Norway spruce
- Austrian pine

Slow Growth Rates
- Noble fir
- Shasta fir
- Alpine fir
- Silver fir
- Colorado blue spruce

3. Adapting Species to Growth Condition. Most growers prefer to plant fast-growing species on poorer, drier soils and slow-growing species on better, moist soils. If they desire to plant several different species, their safest choice may be a compromise between the two extremes. Some growers prefer to plant fast-growing species on better agricultural lands, and control excessive growth by severe leader pruning and shearing. Resulting heavy, dense trees are becoming increasingly popular.

Only trial and error will give the final answer as to which species will be best adapted to any planting site. However, the following procedures will help the grower make a decision.

1. Talk with experienced Christmas tree growers who own plantations where growing conditions are similar. Observe the growth rate and shape of various species in their plantations.

2. Consult with the local forester. If possible, go over the ground with him.

G. SOURCES OF ADDITIONAL INFORMATI

It will pay the grower to consult many sources for Christmas tree inf mation before making his final sele tion. He should obtain advice from a local forester, visit a number of successful Christmas tree farms and obtain available literature.

Reference material is available fro the County Extension Agent. He can also advise growers concerning the availability of assistance from Farm Foresters, Extension Foresters, Soil Technicians or others who can evalu the suitability of lands for growin various species of Christmas trees.

Services of a Farm Forester are ava able to most woodland areas in Oreg and Washington. The office address of the local Farm Forester can be obtained by inquiring at any State District Warden's Office in Oregon or State Department of Natural Resources Office in Washington.

Additional sources of information o growing Christmas trees are:

Local Offices of the Soil Conservation Service

U.S. Forest Service
P.O. Box 3623
Portland, Oregon 97208

Northwest Christmas Tree Associa
The name and address of the current Secretary may be obtair by contacting a Farm Forester c writing to the U.S. Forest Serv at the above address.

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

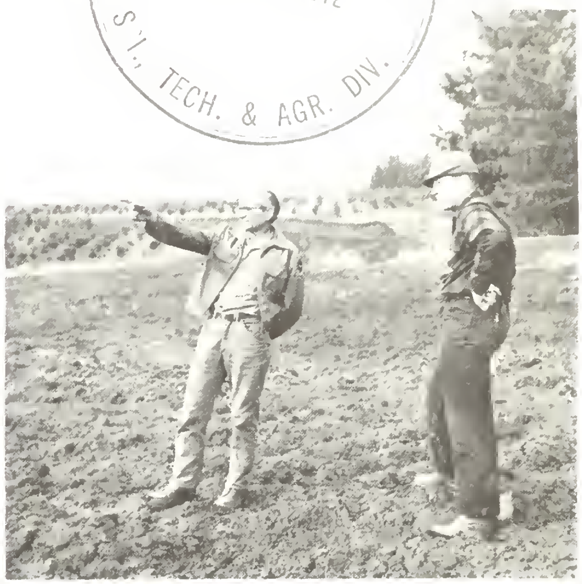
PACIFIC NORTHWEST REGION–STATE AND PRIVATE FORESTRY

PORTLAND, OREGON

No. 4 March 1972

GUIDELINES FOR PROSPECTIVE CHRISTMAS TREE GROWERS

CONTENTS



Prepared by Bernard S. Douglass, U.S. Forest Service, Division of State and Private Forestry, in consultation with Gary H. Sander, Extension Forestry Specialist, Oregon State University. Guidance and assistance was also provided by the Oregon State Forestry Department; Washington Department of Natural Resources; Oregon and Washington Extension Services; U.S. Soil Conservation Service; Forestry School faculties of Oregon State University, Washington State University, and the University of Washington; and member growers of the N.W. Christmas Tree Association.

FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

GUIDELINES FOR PROSPECTIVE CHRISTMAS TREE GROWERS

A. INTRODUCTION

Popular opinion is that Christmas tree growing is merely planting trees, waiting several years, then reaping the profits. Experienced growers, who have gone through the trials and tribulations of producing a crop of high quality trees, may chuckle knowingly on hearing about this myth. However, its credibility is a very serious matter for prospective growers weighing their chances for success.

The purpose of this bulletin is to provide decision-making guidance to persons who are thinking about going into the Christmas tree business either full-time or part-time. The realities of this business are often harsh, and we think they should be presented just as they are. For example, established growers usually have certain advantages over new growers. They have benefits of land and equipment ownership, existing annual income, management know-how, and established marketing outlets. Also, Christmas tree farming, like most other agricultural operations, has shown a trend towards fewer and larger sized operations to keep production costs at a competitive level. However, there are still opportunities for the relatively few new growers, both large and small, who have suitable land and who are willing and able to assume a considerable financial risk, learn and apply tricks of the trade, and put in many hours of hard work.

B. ECONOMIC CONSIDERATIONS

1. **Increasing Competition**. New growers should realize that the Christmas tree business is a great deal more competitive today than it was 5 or 10 years ago. With more and more people growing trees every year, an over-supply situation is beginning to develop. An inevitable result of this increasing competition among growers is that wholesalers, retailers, and consumers can afford to be more choosy as to quality. The lower quality trees become the first casualties in this competitive squeeze, as evidenced by extremely depressed price offers for them or even a complete lack of buyer interest.

To illustrate this point, approximately four times more Christmas trees were planted in Oregon and Washington in 1971 than future markets are likely to absorb. This means that only about one tree out of every four planted expressly for Christmas trees in these two states will be cultured into sufficiently high quality trees to become marketable. High quality Christmas trees are no longer accidents of nature. They are the result of careful matching of species to site and skilled and costly cultural practices.

It is safe to say that established growers will produce most of the future marketable trees and inexperienced growers will produce most of the future unmarketable trees. This does not imply that new growers cannot break into the ranks of successful producers. Nor does it fail to consider that many established growers will drop out of business for reasons of retirement or inability to keep up with constantly rising quality standards. However, it does recognize that persons who are established and experienced in any type of business have considerable advantage over competitors who are just breaking into the business.

2. **Market Trends**. Consumer demands for species, shape, and density of Christmas trees are constantly changing. This makes it very important for growers to anticipate future trends and develop a type of tree that will be in strong market demand 5 or more years after it is planted. Trends in preferred species between 1964 and 1969 are shown in Table 1.

This table indicates that Douglas-fir continues to be the overwhelming favorite in West Coast markets and demand is likely to remain firm for many years. However, its drop from 88 to 83 percent of total production in the 5-year period also indicates that many consumers are willing to try out a new species of Christmas tree. A case in point is the increased popularity of Scotch pine from 1 to 6 percent in the 5-year period. Other good prospects are grand fir, noble fir, and Shasta red fir.

It should be pointed out that a wise choice involves a *desirable seed origin* as well as a *desirable species*. Provenance studies have revealed important differences in both appearance and growth characteristics for various strains, or geographical seed origins, for all

Table 1. – Christmas Tree Production in the Pacific Northwest

1964 and 1969 Comparison*

Species	Year	Oregon	Washington	Total	Precent
Douglas-fir	1964	410,000	2,360,000	2,770,000	88
	1969	525,000	1,890,000	2,415,000	83
Concolor and Grand Firs	1964	120,000	15,000	135,000	4
	1969	95,000	35,000	130,000	4
Noble, Silver, Shasta Red	1964	130,000	25,000	155,000	5
and Alpine Firs	1969	85,000	55,000	140,000	5
Scotch Pine	1964	5,000	20,000	25,000	1
	1969	45,000	120,000	165,000	6
All Other Species	1964	45,000	30,000	75,000	2
	1969	40,000	30,000	70,000	2
Totals	1964	710,000	2,450,000	3,160,000	100
	1969	790,000	2,130,000	2,920,000	100

*1964 and 1969 Special Forest Products Harvesting Reports for Oregon and Washington, U.S. Forest Service, Portland, Oregon. (Quantities rounded to nearest 5,000 trees.)

tree species. This will be discussed in greater detail under "E – Species Requirements." Another genetic improvement is the collecting of seed from specific superior trees (geneotypes) which have been proven by progeny tests to be capable of producing seedlings having better-than-average inherited Christmas tree characteristics.

A significant trend in market demand is a growing preference for sheared trees. Sheared Douglas-fir, for example, increased from less than 1 percent of the total Douglas-fir cut in 1960 to about 25 percent in 1970. A continued rise in demand for sheared trees, and a corresponding decrease in demand for unsheared trees, is also predicted for other species.

Table 1 indicates that, contrary to popular belief, total production of Christmas trees in the Pacific Northwest is actually declining. Statistics show a delcine of 6 percent between 1959 and 1964 and a decline of 7 percent between 1964 and 1969. Why is this happening in face of growing population? The answer is a combined impact of more artificial trees, competition of Lake States Scotch pine in our southwestern markets, and reluctance of buyers to risk having large unsold inventories of today's higher priced trees. The best way to counteract this downward trend is to produce a better quality tree through genetic and cultural improvements.

3. **Need for Working Capital**. Growing Christmas trees of sufficient quality to meet today's market demands is an expensive proposition. Moreover, the grower's capital investment may be tied up for 6 years or longer before the first dollar return. Cost studies[1] have shown that a total investment of about $1.50 per tree is required to develop a 6½-foot sheared Douglas-fir during an 8-year rotation. Assuming a normal stocking of about 1,300 trees per acre, this would mean an investment of about $1,950 per acre. A little more than half of this investment would be in terms of labor that a small operator could perform and earn by not having to hire help. The balance of the investment would have to be in terms of out-of-pocket costs for such items as taxes, planting stock, equip-

[1] Gary H. Sander and Dr. Robert F. Keniston, Oregon State University, "Cost Data for a Christmas Tree Operation," November, 1970.

ment, tools, and chemicals. This would mean that even a 10-acre plantation could require from $9,000 to $19,000 depending on how much labor the grower himself performed. A person unable or unwilling to make such an investment should not start a Christmas tree farm.

4. **Availability of Labor and Specialized Equipment.** Larger acreages or limited amount of working time would necessitate hiring labor for many tasks such as planting, basal pruning, shearing, and spot spraying with chemicals. A person with physical limitations would need to hire most of the labor, of course, and act principally in a supervisory capacity. All except the smallest growers should plan on hiring extra help during the harvesting season. These labor requirements are brought out to illustrate the need for an available labor supply and the job training necessary to make the labor efficient. Persons living in isolated areas, or who lack training skills, find that labor shortages can be a critical factor.

Christmas tree growing requires specialized equipment, some of which has little application to normal farming needs. This includes planting machines, airplane or helicopter sprayers, narrow gauge sprayers, tillers and mowers, shearing and pruning tools, light chain saws, and tractors and wagons. Some of this equipment might be purchased by the grower; but other costly and infrequently used equipment, such as planting machines and aircraft, is normally rented. Therefore, it is important for a new grower to ascertain the availability of any equipment that he must plan to hire.

5. **Profit or Loss Possibilities.** As discussed under "3 – Need for Working Capital," a total investment of about $1.50 (1971 estimate) is required to develop and deliver a 6½-foot tall sheared Douglas-fir to a roadside loading point. This is equivalent to $1,950 per acre if we assume a stocking of 1,300 marketable trees per acre. If these trees are sold wholesale at roadside for 50 cents per lineal foot or $3.25 per 6½-foot tree, the grower could expect to make a net profit of $1.75 per tree or $2,275 per acre.

A new grower might look at these estimates and say, "Wonderful! To what other use could I put my land that would net $300 per acre per year!" At this point we should again remind the reader that statistically only one tree out of four planted for Christmas trees will likely ever develop sufficient quality to reach the market place. The grower is likely to lose his entire investment in the remaining three out of four trees. As the old saying goes, "There is many a slip between the cup and the lip." The above projected profits assume that everything goes well and according to plan all the way from the planted seedling to the sold and harvested tree. Profits actually do not usually work out in such an ideal manner, as any experienced grower will testify. One way for a new grower to avoid or lessen possible losses on timber-type ground is to plant Douglas-fir. If for any reason his Christmas tree plans do not materialize, then he can let the trees grow on to timber size. This would not work out, of course, for most pines and true firs since they have little potential for growing into timber.

The cost and return picture would be somwhat different for pines and true firs. Sheared pines might cost an additional 25 cents per tree to produce with a year longer rotation than Douglas-fir. This might be compensated for by a somewhat higher wholesale price at roadside. Costs of producing high quality sheared true firs would likely exceed $2 per tree over a 9-year rotation. This, together with relatively low yields of merchantable quality trees per acre, explains why the wholesale price for true firs is frequently 50 to 100 percent greater than Douglas-firs.

C. PERSONAL REQUIREMENTS

1. **Interest and Enthusiasm.** Thus far, we have discussed only economics. The human factors are equally important for successful Christmas tree growing.

A frequently overlooked question that every potential Christmas tree grower should ask himself is: "Do I really like growing and working with trees?" If an honest answer to this question is "No," one's motivating interest must be assumed as strictly a desire for an attractive return on an investment.

However, case histories of growers with disinterested outlooks indicate that most of them fail to develop trees of competitive quality. They find that the required day-by-day cultural work becomes monotonous and, sometimes, downright tedious. Under such circumstances it is not surprising that drive and incentives to attain cultural perfection is frequently wanting. Unless a disinterested person is able to hire a professional manager to grow his trees, he is well advised not to invest his time and money growing Christmas trees.

Prospective growers who wish to sell their own trees retail, either at a Christmas tree lot or on a choose-and-cut basis at the tree farm, should ideally have selling ability and a tolerance for mixing and dealing with all kinds of people. A lacking of such aptitudes would be of lesser concern, however, to persons who intend to sell their trees wholesale.

2. **Technical Knowledge and Training.** New growers have a number of good sources for information on Christmas tree growing. They are urged to make full use of these facilities. Much experimental work has already been accomplished on a wide range of Christmas tree subjects including seed sources, site selection, ground preparation, planting, herbicides, insecticides, fungicides, animal damage, shearing techniques, and basal pruning. Trial and error is one approach to learn the basic techniques for producing high quality trees, but it can also be very time-consuming and costly. A wise grower tries to avoid repeating the same old mistakes that have been tried and discarded by thousands of growers throughout the Christmas tree producing regions of this country during the past 20 years. Instead, he follows the proven basics; then refines and polishes them on an experience basis to fit his own particular site conditions.

Following are good sources of basic information for new Christmas tree growers:

a. **Consult With Successful Growers.** "Nothing succeeds like success." An established grower who produces high quality trees that are in strong market demand has obviously learned the tricks of the trade. His competency is proven by the fact that he has survived and risen to the top in a very competitive business. Many successful growers are willing to help train new growers and help them make critical decisions and solve perplexing problems. The best way of all to learn about the business is to go to work for a successful grower. You can be sure that the working techniques and guidelines that he insists you follow are pretty sound.

b. **Consult With Your Farm Forester.** Farm Foresters are the principal source of on-the-ground service and advice to all woodland owners, including Christmas tree growers. There is no charge for their services. They may be contacted at local Department of Natural Resources offices in Washington and State Forestry Department offices in Oregon. Many Farm Foresters work regularly with Christmas tree growers, and are able to call on specialists if an unusual problem comes up.

c. **Consult With Your Extension Agent.** Most Extension Agents can provide assistance in Christmas tree growing or advise growers where to obtain such assistance. They may be contacted at Agricultural Extension offices at the County Courthouses. They can provide the latest literature on Christmas tree growing and can obtain technical assistance on many facets of Christmas tree growing from State University scientists and Extension Forestry Specialists. Extension Agents periodically sponsor field trips at local Christmas tree farms in cooperation with growers, Farm Foresters, Soil Conservationists, and others to demonstrate successful techniques. Both the Oregon State and Washington State Extension Services provide biennial 2-day short courses for Christmas tree growers. Your local Extension Agent can provide information on time, place, and agenda of these training sessions.

d. **Join a Christmas Tree Association.** The Northwest Christmas Tree Association provides meetings, field tours, culturing demonstrations, trade fairs, and current literature for its members. Most successful Oregon and Washington growers are members. The name and address of the current secretary may be obtained from your Farm Forester or Extension Agent.

e. **Read Up-to-Date Literature on Christmas Tree Growing.** New information on Christmas tree growing is being constantly developed by foresters, researchers, and growers. Therefore, most older references are obsolete. The following general references are currently up-to-date and provide useful information:

Name of Reference	Where It May be Obtained
"Raising Christmas Trees for Profit," PNW 6, Revised March, 1969	Agricultural Extension Offices at County Courthouses
"Cultural Practices for Growing Christmas Trees in the Pacific Northwest," Forest Service Managing Your Woodland Guide #5, Revised June, 1967	Div. of State & Private Forestry, U.S. Forest Service, P.O. Box 3623, Portland, Oregon 97208 Farm Foresters Offices at State Forestry Field Headquarters Agricultural Extension Offices at County Courthouses
"Christmas Tree Harvesting and Marketing for Pacific Northwest Growers," Forest Service Managing Your Woodland Guide #8, Revised April, 1971	Same as above
"Development of High Quality Sheared Douglas-fir Christmas Trees," Forest Service Managing Your Woodland Guide #12, Revised June, 1971	Same as above
"Development of High Quality Sheared Pine Christmas Trees," Forest Service Managing Your Woodland Guide #13, Revised July, 1968	Same as above
"Development of a Plantation of High Quality True Fir Christmas Trees," Forest Service Managing Your Woodland Guide #14, August 1972	Same as above

f. **Learn From Actual Experience.** Experience is still the best teacher and, in the long run, the only way to become a successful grower. After learning the fundamentals from the previous sources, apply them on the ground; avoid major innovations of the prescribed and proven practices. When trying seed sources, keep good data records for future reference.

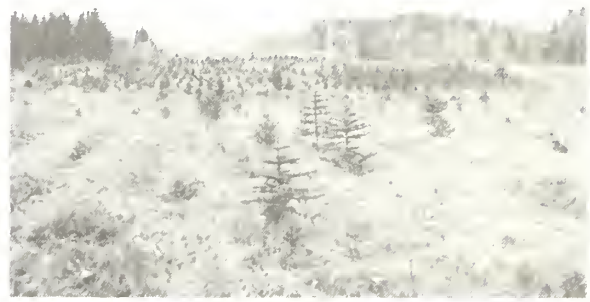
3. **Physical Fitness.** Good physical condition, as well as an enthusiastic temperament, are desirable attributes for success. This does not imply that a reasonably robust older person should not consider growing Christmas trees. As a matter of fact, men and women past retirement age are frequently among the most skillful growers. What it does imply is that physical limitations make any type of farming more difficult. Each person should realistically appraise his health, strength, and endurance in relation to the size and type of workload that he plans to undertake. Sometimes the hiring of a strong, young person for particularly strenuous tasks will solve a problem for a manager who is quite capable of supervising the work of others and performing the lighter tasks himself.

4. **Available Working Time.** "Time is Money" -- so goes the old adage. Certainly, available time is an essential requirement for managing a successful Christmas tree growing operation. And the amount of available time largely sets the limits on the size of operations. A robust, full-time grower planning to do most of his own work could normally expect to handle a maximum 80-acre plantation on an intensively managed basis without having to hire a great deal of help except during the harvesting season. On the other hand, a working or retired person wishing to put in only 1 or 2 days of work per week is advised to hold down the size of his operation proportionally — say to 10 or 20 acres — unless he plans to hire help.

D. LAND REQUIREMENTS

1. **Do You Already Own the Land or Must You Buy It?** This is an important question from the standpoint of both economics and Christmas tree land suitability. Cleared agricultural lands well suited for Christmas tree plantations are becoming increasingly expensive and hard to find. A prospective Christmas tree grower who already owns such land is indeed fortunate to be able to start out with an economic advantage over competitors who must purchase their land. However, prior ownership also narrows one's options because the land *may* or *may not* be suitable for growing Christmas trees. If a careful analysis shows that his land is unsuitable for this purpose, a prospective grower will be wise to either drop the project or plan to buy another parcel of land that does meet the exacting requirements for good Christmas tree development.

A person planning to buy Christmas tree land has many choices and he should make the best selection that he can afford. A grower needs to take advantage of every possible competitive edge. No matter what other ingredients of success he may possess, a prospective grower has little chance against his competitors unless he makes a wise land selection. He is strongly advised to seek on-the-ground evaluations by foresters, horticulturists, soil scientists, and successful growers before deciding to buy any parcel of land for growing Christmas trees.



Growing Christmas trees under power lines may be excellent land use where the site is suitable. Arrangements must be made with the power company to prevent spraying of brush killing chemicals on the plantations.

2. **How much Land?** Christmas tree farms vary from an acre or two for a weekend hobbyist to several thousands of acres for a few large Christmas tree companies. The size of operation will depend on both available working time and working capital.

A full-time grower planning to do most of his own work may be able to handle an 80-acre plantation. A semi-retired or weekend grower should plan proportionally smaller operations. It should be pointed out that very small growers have the following disadvantages:

a. Too little volume to justify purchase and amortization of labor-saving equipment.

b. Difficulty in assuring a buyer that he can purchase an adequate even-flow of trees year-after-year, or a variety of species from which to choose.

However, skilled smaller growers also have one big advantage over large growers. Whereas the large grower must hire crews to perform his cultural work, the small grower usually performs or supervises this work personally. If

he is able to combine cultural skill with high motivation that so often characterizes the entrepreneur, he may attain a degree of tree quality perfection seldom equalled on larger operations.

3. **Fertility and Soil Type.** Ideal plantation land should be reasonably fertile and produce a moderate growth rate equivalent to low Site II or Site III. Many marginal westside hill farmlands rated only marginal for other crops such as grain, berries, hay, and pasture fall into this category. Typical lands with Christmas tree plantation potential are found on lower slopes of the Umpqua, Willamette, Cowlitz, and Chehalis River valleys, as well as on some of the well-drained alluvial valley lands and more fertile glacial till lands in the Puget Sound Basin. Gently sloping hillsides, upland benches, or rolling lowland fields may be good prospects.

Very fast growth rates equivalent to high Site II or Site I are usually less desirable. Rapid growth often causes coarse, unwieldy branches and heavy suckers. Such sites are frequently associated with heavy rainfall which encourages infections by Rhabdocline needle cast and other diseases. Moreover, rapid tree growth is commonly associated with rapid growth of weeds, grass, and hardwoods which compete with trees and are costly to control.

Very slow growth rates, characteristic of Site IV or V, are also usually less favorable than moderate growth rates. Shearing response and development is too slow unless fertilizers are applied to stimulate growth rate, color, branch stiffness, and density. Typical soils that may produce excessively slow growth rates are gravelly glacial tills, heavy clays, and shallow top soils overlaying bedrock or hardpan. Poorly drained river bottom soils, too, may produce unsatisfactory tree growth despite their fertility for growing truck gardens or other annual crops. Frequent disadvantages of such river bottom sites are lush growth of competing grass and weeds, excessive rodent populations, frost damage from poor air drainage, and high water tables.

Heavy concentrations of large rocks should be avoided. They impede the operation of cultivating, planting and mowing equipment, and result in high equipment maintenance costs. Shallow soils overlaying rock should be avoided for the same reasons, together with the fact that such soils tend to dry out quickly and retard tree growth. Hardpan layers lying close to the surface should be avoided unless a subsoiler is used to break it up to a depth of at least 12 inches.

Extremely rocky and infertile soils such as this usually produce slow growth and long rotations under even favorable moisture conditions. Prolonged summer draught may cause heavy mortality and shock to planted seedlings.

4. **Water Drainage.** Poorly drained fields should be avoided. Indicators of poor drainage are standing water during prolonged rainy periods, summer wet spots, saturated soil within a few inches of the surface during normal weather periods of either summer or winter, and presence of water-loving plants such as wire grass, water sedges, skunk cabbage, buttercup, and angelica. Small, localized wet spots may be tolerated in a plantation if planted with Scotch pine or shore pine. However, wet soils are not as desirable as well-drained soils for any species. They cause poor growth and survival, leaning stems, and excessive growth of competing grass and weeds.

5. **Air Drainage.** Good air drainage

The year-around wet spot in this field is caused by a spring or seep. It can be detected at any time of the year by presence of wire grass and other water plants. Trees planted here are almost sure to drown out unless the spot is drained.

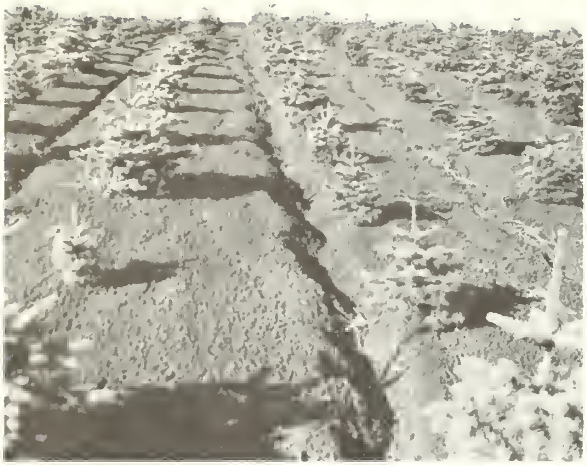
Lands subject to seasonal flooding are unsuited for growing Christmas trees. Since floodable lands frequently appear quite normal during the dry season, it pays to check for standing water during periods of heavy, prolonged winter rains. Other sources of information are local residents and Soil Conservation Service specialists who are familiar with the drainage characteristics of the land.

implies a slope, hilltop, or upland bench where cold air will not collect and kill the newly sprouted buds during the early spring growing period. Freezing air, like water, has a tendency to flow downward into flat areas, valley bottoms, and natural bowls which are known as "frost pockets." Symptoms of frost damage are withering and killing back of the new growth sprouts. Douglas-fir, true fir, and spruce are quite susceptible to frost damage. Pines are resistant.

6. **Animal Damage Potential**. Browsing of succulent growth tips by deer and elk may be a serious problem, especially where plantations adjoin extensive wooded areas or where the game animals are over-stocked. Cattle, horses, and sheep, too, will cause browsing and trampling damage in unfenced Christmas tree areas. Meadow mice may inflict considerable damage by girdling the stems of smaller trees near the groundline. However, such damage normally occurs only where uncontrolled grass and weeds provide cover for these small rodents. A very serious rodent pest is the pocket gopher. The roots of Scotch pine and Austrian pine are one of its preferred winter foods. Management of these pines may be impossible in heavily gopher-infested areas without an intensive baiting or trapping program. Wherever a potential animal damage problem exists, a grower should plan to exclude or eliminate the source of the problem. Personnel from the State Game Departments, U.S. Fish and Wildlife Service, and State Universities can provide advice and assistance.

7. **Trespass**. Theft is less likely to occur when the trees are growing on your home property and can be watched. The best solution for absentee owners is to establish their operation on a private road with controlled access. Where this is not possible, signs, fences, and locked gates should be planned. Problem areas may require patrolling during the Christmas tree cutting season. Cooperative neighbors living near your tree farm or local law enforcement officers may also deter seasonal trespass.

8. **Fire Hazards**. Fire damage is not a



Sustained slopes of more than 10 percent should be avoided in selecting a plantation area. Chemical eradication of grasses and weeds on this 15 percent slope resulted in severe erosion of valuable top soil.

serious problem on plantations where flammable grasses and weeds are effectively excluded by herbicide chemicals or cultivation. However, areas containing dry grass and weeds are potential tinder boxes. In this case, vegetation-free firebreaks should be maintained around the perimeter and along principal harvest roads until existing flammable material decays and future growth of grasses and weeds is checked.

9. **Steepness of Slope**. Gently sloping or nearly level ground is more desirable than steep ground for growing Christmas trees. Erosion is less severe. Fires do not run as fast. Men and equipment can work more efficiently. Sustained slopes of less than 7 percent are most desirable. However, short pitches up to 15 percent may be tolerated where topography is generally favorable.

Certain soil types, especially those that are sandy or friable, are particularly susceptible to erosion. A light cover crop of grass or clover may be desirable to bind such soils on the steeper slopes.

10. **Aspect (Direction of Slope)**. True firs prefer northerly and easterly slopes where

Roots of horsetail prevented erosion on this area, which is similar and adjacent to the eroded area shown on the left. It did not appear that this Atrazine-resistant plant competed seriously with the Christmas trees. A partial ground cover to prevent erosion can also be maintained by omitting the Atrazine spraying and, instead, mowing between the rows. Another possiblity is spraying only around the base of each tree or in narrow bands that follow the contours of the ground.

some protection is afforded from heating and drying during hot weather periods. Pines, being sunlight lovers, prefer level to gently southerly or westerly slopes. Douglas-fir will tolerate any aspect, but it is easiest to manage on slopes of less than 7 percent.

11. **Elevation**. Douglas-fir grows naturally from sea level to several-thousand-foot elevations. Plantation elevations of less than 1,000 feet are recommended to lessen the chances of snow breakage.

The principal pines (Scotch, Austrian, shore and white) all develop best below 500-foot elevations. They are relatively susceptible to breakage and crooked stems caused by heavy wet snow.

Noble and Shasta firs, being native to high elevation sites, are naturally resistant to snow damage. The best plantations of these high elevation true firs have been developed from

500- to 2,000-foot elevations. However, they will also grow at lower elevations on north and east slopes and other situations where soil moisture and fertility is adequate for good growth.

12. **Competition from Grasses, Weeds, and Brush.** Plantation sites containing heavy stands of chemical-resistant species such as Canada thistle, wild cucumber, morning glory, blackberry, perennial rye grass, orchard grass, alta fescue grass, and quack grass should not be planted with trees until these species have been eradicated by repeated cultivation or by applying chemical sterilants. This may require a year or longer of ground preparation before the area is planted. Your neighbor's ground, too, has a bearing on your grass and weed control. If he does not control undesirable grasses and weeds, they will continue to spread by means of seeds or runners.
Natural areas should contain a minimum of brush, hardwood trees, bracken ferns, tall weeds, and unwanted coniferous species. For this reason, it is frequently desirable to select a low site such as the southern Puget Sound glacial tills, where growth of such competition is light. Then build up the site artificially around each tree by direct application of a nitrogen fertilizer.

Adjacent timber stands adversely affect a plantation through root competition and excessive shade for a distance equal to the tree heights. Note the reduced growth and vigor near the timber edge.

Quack grass is difficult to eradicate and competes for moisture and nutrients with Christmas trees. Note the lack of vigor in the tree planted in a patch of quack grass in the foreground.

In deciding whether to leave a shade tree within a plantation, a grower should weigh its aesthetic value against the considerable loss of Christmas tree production caused by shade and root competition.

13. **Competition from Larger Trees.** Adjacent or intermingled larger trees reduce both production and quality. Shade and root competition causes weak branches, slow growth, and sparse needles; especially when competitors are within tree height and south or west from the Christmas trees.

Pines are more intolerant of shade or root competition than any other species and actually seem to lean or cringe away from their larger competitors. True firs are most tolerant in this respect, with Douglas-fir intermediate.

Some growers attempt to grow timber and Christmas trees on the same area and at the same time. They may plant Douglas-fir 5 feet apart, for example, and develop sheared Christmas trees from all trees in alternate rows and alternate trees within timber tree rows. This is not usually successful in practice for Douglas-fir. The timber trees tend to overtop and crowd the much shorter sheared Christmas trees. Heavy and costly pruning of the side branches on the timber trees is necessary to reduce shading and suppression. Christmas trees also suffer in quality from root competition caused by the timber trees. However, combining Christmas tree production with timber production may be practical for a *single rotation* of high elevation true firs such as noble fir growing on their natural sites. Here the Christmas trees normally receive little shearing and develop at about the same rate as the intermingled timber trees.

14. **Eastside vs. Westside Sites.** About 95 percent of the combined Oregon and Washington Christmas tree production is from west of the Cascade summit. Temperate marine climatic conditions found in this area are generally very favorable for tree growth.

Most Christmas trees produced in Eastside plantations are either irrigated or are from moister, higher elevation sites where natural forests grow or once grew. Native Christmas tree species planted in Eastside plantations should be of Eastside origin rather than the more freeze-susceptible trees of Westside origin. By the same token, Westside sites should usually be planted with seedlings of Westside seed origin, although grand fir may be an exception to this rule. Eastside Douglas-fir planted on Westside sites, for example, frequently develop Rhabdocline needle disease and grow exessively slow.

15. **Accessibility.** Accessibility includes several factors. Consider the following:

a. Do you have a right-of-way or easement to a public road?

b. Is the area reasonably close to your home or center of operations?

c. Does it have an all-weather access road to facilitate culturing and harvesting operations?

d. Could early snowfall stymie planned harvesting operations?

e. Is the area so far removed from population centers that hiring of labor could be a problem?

f. Buyers will travel considerable distances to look over and purchase quality trees. However, growers in remote areas must make a special effort to establish buyer contacts until they establish a reputation for high quality production.

E. SPECIES REQUIREMENTS

1. **Matching Species and Strains to Site.** Proper matching of species to site is one of the most important determinations that a Christmas tree grower must make. He must first decide if his land is well suited in general for growing Christmas trees, as discussed under Section "D – Land Requirements." Then he must determine which species or strains are best adapted to that particular site. Some sites are well suited for growing only a single species. Others may offer a choice of 2 or more species. Where several species are to be grown on one planatation, the grower should subdivide his area into several planting units for the purpose of matching the best adapted species to each unit.

Assume, for example, that a 20-acre plantation site ranges from 300 to 400 feet in elevation and is bisected by a ridge running east and west. The north exposure slopes at 6 percent between the ridge top and the north boundary. The south exposure slopes at 10 percent between the ridge top and a flat

valley bottom containing a stream which forms the south boundary. This flat area is assumed to be subject to late frosts, but lies above the flood plain and is reasonably well drained. What species should be planted where?

The north slope would be the best site for planting the true fir species in this hypothetical example. Grand fir would be adapted to growing under a wider range of climatic and soil conditions than either noble fir or Shasta red fir. Shasta red fir would be a better choice than noble fir on warmer, drier north slopes, but the reverse would hold true on cool damp sites where soil is subject to seasonal water saturation. Douglas-fir would also be a good prospect on most gentle northerly slopes.

Assuming the ridge top to be somewhat flat, Douglas-fir would normally be considered a good bet here. However, if the ridge is swept by strong prevailing winds, Douglas-fir is likely to become one-sided and distorted on the windward side. In this case, the grower should consider a stiff, rigid species that resists wind deformation, and at the same time will tolerate moderately dry soil conditions that are typical of exposed ridges. Either grand fir or Scotch pine might be considered here.

The south slope is moderately steep and exposed to the maximum heating and drying effect of the sun. Pines may be the best prospect on such relatively severe sites, especially where the topsoil is thin or lacking in nutriments. Pine is probably the "toughest" of all Christmas trees. However, if the soil is reasonably fertile and deep, Douglas-fir, too, might be a good prospect.

The valley bottom, being subject to frosts, requires a frost resistant species as well as a moisture tolerant species. Scotch pine is the best choice in this respect. If Douglas-fir or grand fir is planted here, it should be a late bud bursting strain such as the Forks, Washington, and Blodgett, Oregon, strains of Douglas-fir and the central Idaho Panhandle strains of grand fir.

In general, pines are better able to *endure* winter freezing, late frosts, wet soils, drought, and high summer temperatures than other species. However, this is not intended to imply that adverse sites are *desirable* for pines, which will actually develop better quality Christmas trees over shorter rotations on more favorable sites. It simply means that pines might be the *only possible choice* on severe south exposures, frost pockets, and wet spots. Marginal tree growing sites east of the Cascade summit will sometimes support Scotch and Austrian pine where other species would fail. However, the main production areas for pine should be concentrated on fertile, well-drained, gentle terrain where growth is vigorous, rotations are short, and production costs are moderate.

True firs, especially noble and Shasta, prefer cooler and moister sites than other species. Desirable site characteristics for true firs include northerly to easterly aspects, deep fertile soils, and moderate temperatures and rainfall. They will resist snowbreak, bent stems from snow weight, and wind deformation better than either pines or Douglas-fir. Westside sites above about 800-foot elevation, where heavy winter snows are experienced, will usually support noble and Shasta fir better than any other species. However, it is almost always a waste of time and money to plant these moisture-loving species east of the Cascades summit. Little is known at this time about best Christmas tree strains of noble fir, although provenance testing for this species is now under way. Grand fir provenance tests have determined that Central Idaho Panhandle seed origins are a preferred strain for Westside Christmas tree plantations.

Douglas-fir is perhaps the most versatile Christmas tree species in the Pacific Northwest, as well as the most popular by a wide margin. It develops more rapidly than any other native species and, with proper culture, produces a high percentage of marketable trees on a variety of exposures, elevations, climatic conditions, and soil types. However, it has some weaknesses and limitations. For example, sheared trees are quite subject to snowbreak at higher elevations and strong prevailing winds will cause unsymmetrical crowns. It will not stand wet soils, frost pockets, heat, or dryness as well as most pines. The best seed source for Christmas trees will depend on the latitude,

elevation, soil type, temperature extremes, and moisture conditions at the planting site. Some of the seed sources in popular demand by Christmas tree growers are Shelton, Washington, 1,000-foot elevation; S.E. Vancouver Island, B.C., 2,000-foot elevation; Tualatin Valley, N.W. Oregon, 1,000-foot elevation; and Benton County, Oregon, 1,000-foot elevation. Here is a good rule-of-thumb for selecting a frost-resistant strain of Douglas-fir planting stock: Choose a seed source of either the same or a more northerly latitude than the planting site. Also, choose a seed source of the same or a higher elevation than the planting site.

Some species are not generally recommended because of poor site adaptability, undesirable characteristics, and small market demand. These include concolor fir, Sierra redwood, spruces, most Mediterranean strains of Austrian pine, and winter-yellowing strains of Scotch pine from Northern Europe and Asia. If tried at all, plantings of these species and strains should be confined to a small experimental scale.

2. **Market Demand for Various Species.** Douglas-fir is the mainstay of most buyers. It comprised about 83 percent of the total combined Oregon and Washington Christmas tree harvest in 1969, and appears unlikely to loose its lead in the near future. Sheared Douglas, especially plantation-grown, are rapidly displacing unsheared Douglas. Genetic improvement is currently underway to improve quality through selection of elite individual seed trees.

Scotch pine was second in popularity with 6 percent of total production in 1969. Good needle durability and traditional preference by people who moved to the West Coast from the Eastern and Lake States are likely to result in further modest increases in its popularity. Desirable blue short needle strains of Scotch pine include Spanish, Turkish, and French Auvergne. Desirable bright green, moderately long needled strains include Southern German, Northern French, and the British Isles.

High elevation true firs, principally noble and Shasta red, accounted for about 5 percent of 1969 production. They are difficult to develop and are very particular as to site, but command the highest market price--almost double that of Douglas-fir. Modest increased demand is predicted during the next decade.

Grand fir accounted for about 4 percent of 1969 production. It has been hampered somewhat by needle retention problems, but recent provenance tests may have largely solved this problem by pinpointing desirable seed origins. Its close relative, the *concolor* fir, is a beautiful tree but plagued by poor growth and needle retention problems. Central California seed sources appear to produce the best concolor fir but large scale plantings of any concolor fir strain cannot be recommended at this time.

Vienna, Austria, strains of Austrian pine, and Southern Oregon Coast strains of shore pine have produced some good sheared Christmas trees, but results are not always consistant. Only limited plantings are suggested for these pines.

Market demand for cedar, spruce, Sierra redwood, and Monterey pine is quite limited due to poor growth, poor needle retention, or long established buying habits of customers. Large scale plantings are not recommended as they would likely be difficult to sell.

3. **Harvesting Rotations for Various Species.** Douglas-fir can be developed to marketable size sheared trees quicker than any other principal Northwest Christmas tree species. Rotations as short as 7 years have been experienced for well-managed plantations established on exceptionally favorable sites. In these cases, a portion of the trees reach 6– to 7–foot heights and marketable quality after only 5 growing seasons in the field. The second and heaviest cut is made during the following year after 6 growing seasons. The third and final cut is made after the 7th growing season. The stumps and cull trees are then ready to be removed in preparation for planting the next crop of

Christmas trees. Longer rotations than 7 years should be expected, however, for most Douglas-fir plantations. Rotations of 8 years are probably average, and 9 year rotations could be expected on infertile, slow growth sites. Even longer growing periods (9 to 12 years) are usually required for sheared cultured natural Douglas-fir due to competition for sunlight and moisture by intermingled native hardwood trees, brush, ferns, weeds, and grasses.

Rotations for growing pine Christmas trees are usually about 2 years longer than for Douglas-fir. Pines lack internodal branches and, therefore, must be developed only about a foot in height growth each year to prevent excessively long, bare gaps between branch whorls. Pines are also more prone to develop crooked stems than Douglas-fir, and this frequently necessitates higher basal pruning to find a straight handle. Faster developing pines include long-needled Scotch pine strains, such as from Scotland and southern Germany, shore pine, Austrian pine, and white pine. Slower developing pines include short needle strains of Scotch pine such as French Auvergne, Spanish, and Turkish.

These Douglas-fir and noble fir trees were planted on the same day 4 years ago. The faster growing sheared Douglas-fir will all be harvested after only 7 growing seasons. At least 3 additional growing seasons will be required for the noble fir. Moral: The most expensive *product is not necessarily the most* profitable *one.*

Rotations for developing all species of true firs are longer than for Douglas-fir. The fastest growing true fir species, grand fir, requires only a year or two longer to develop than Douglas-fir. However, noble fir, Shasta red fir, and Fraser fir frequently require 3 years or longer to develop than Douglas-fir. This helps to explain why these species command relatively high market prices.

F. SUMMARY

A prospective Christmas tree grower should explore every possible source of information to help him make wise decisions. His first decision, of course, should be whether it will pay to go into this business at all. If a careful and objective analysis shows a good chance of making it a success, the next step is to start selecting a suitable site and learning the art of growing high quality Christmas trees. We have repeated the words "high quality" many times over because it is the real key to producing a salable and competitive product. High quality is seldom an accident of nature but, instead, a time-consuming and costly manipulation of natural trees and their environment.

Lest we end this discussion on a negative note, we would like to state that Christmas tree growing can be both financially and spiritually rewarding to qualified prospective growers. We have emphasized the pitfalls, not to discouage those who are well qualified, but to discourage financial loss and disappointment by those three out of four new growers whom statistics tell us will fail to develop salable trees.

G. SOURCES OF ASSISTANCE AND INFORMATION

Farm Foresters are principal sources of on-the-ground assistance to Christmas tree

growers. Their services are available without charge to woodland owners in most areas in Oregon and Washington. The office address of the local Farm Forester can be obtained by inquiring at any State Forestry Department Office in Oregon or State Department of Natural Resources Office in Washington.

Assistance and reference material is available from your County Extension Agent. He can also advise growers concerning the availability of assistance from Farm Foresters, Extension Foresters, and others who work with Christmas tree growers.

Additional sources of Christmas tree culturing information are:

Extension Forestry Specialist
Agricultural Cooperative Extension Service
117 Forest Research Laboratory
Oregon State University
Corvallis, Oregon 97331

Extension Forest Resources Specialist
Agricultural Cooperative Extension Service
Washington State University
317 Johnson Hall
Pullman, Washington 99163

Extension Forestry Specialist
Agricultural Cooperative Extension Service
Western Washington Research and
Extension Center
Puyallup, Washington 98371

Special Products Forester
Division of State and Private Forestry
U.S. Forest Service
Post Office Box 3623
Portland, Oregon 97208

Local offices of the Soil Conservation Service

The Northwest Christmas Tree Association provides meetings, field tours, culturing demonstrations, and current literature for its members. Most Oregon and Washington growers and wholesalers belong to this association. The name and address of the current secretary may be obtained by contacting any of the above-mentioned sources of information.

Both the Oregon State and Washington State University Extension Services provide biennial 2-day short courses for Christmas tree growers. Your local Extension Agent can provide information on time, place, and agenda of these training sessions.

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CULTURAL PRACTICES FOR GROWING CHRISTMAS TREES IN THE PACIFIC NORTHWEST

CONTENTS

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CULTURAL PRACTICES FOR GROWING CHRISTMAS TREES IN THE PACIFIC NORTHWEST

A. INTRODUCTION

This bulletin describes various cultural practices that are used to grow quality Christmas trees in the Pacific Northwest. Many of the described practices apply to both cultured natural stands and plantations. Others apply specifically to one or the other.

More than 40% of the trees cut in the Pacific Northwest in 1959 were cultured. The trend is toward more cultured trees and fewer natural trees. This is primarily due to growing consumer demand for high quality trees. It is also caused by a scarcity of satisfactory natural trees available for Christmas tree cutting.

Cultural practices are not a cure-all for unsuitable Christmas tree sites. Many sites are too poor to produce healthy trees with good form and color. Other areas produce fast, open growth and are much better suited for growing timber than Christmas trees. Wise growers do not attempt to fight adverse tendencies on unsuitable land. They choose the best available type of Christmas tree land and apply sufficient cultural practices to attain high production of quality trees. Like any other business, Christmas tree growing is highly competitive. Competition can best be met by producing a superior product.

The cultural practices covered in this bulletin are in current use. New techniques are being developed by growers and experimenters. Techniques that work for one grower may not work for another who has different species, rainfall, slope, elevation, or soil type. Some growers produce good quality trees by thinning and pruning. Others find it necessary to resort to additional practices, such as shearing, to get desired results. It is up to each grower to determine, through trial and error, the practices which are best adapted to his Christmas tree area.

B. DEVELOPING A NATURAL STAND

Natural stands suitable for Christmas tree culture contain many thrifty young trees of Christmas tree size or smaller. A few trees may shape up quite well under natural conditions. Most of them will not develop into high quality Christmas trees unless they are cultured. Some are growing too close together for good branch development or are suppressed by competing hardwoods. Others have ample space to grow but are lopsided or spindly. By culturing suitable natural stands, the grower can improve tree quality to produce up to 20 times as many merchantable trees on the area. At the same time he can attain a sustained production, year after year, by selective removal of all trees before they exceed Christmas tree size.

1. Planning the Work

More Christmas tree operations fail through lack of good planning than for any other reason. The key to a successful operation is the development of a sound "work plan" before the job is started. The plan should be based on a careful analysis of what jobs need to be done, how they will be accomplished, and the priority of each job. Experienced growers may only need to develop a logical plan of action in their minds. Inexperienced growers are advised to write down their work plan and have it reviewed by farm foresters, county agents,

successful growers, or other Christmas tree specialists. They are also advised to get as much background knowledge as possible by reading Christmas tree prublications, participating in local farm forestry and Christmas tree associations, and looking over cultural demonstration areas.

Individual work plans will vary, of course, with both site conditions and circumstances of the grower. The following guidelines are applicable to work plans for developing most new areas:

a. Make a list of all jobs that should be done. Include those needed to develop the area and protect the trees, as well as those needed to culture the trees.

b. Decide the season that each job should be done. Culture as many trees as possible during the dormant season, August to May. Trees cultured during this period will have a head start by being prepared for the growing season. The timing for certain jobs, such as shearing pines, chemical brush control, and slash burning is closely controlled by the season of the year.

c. Give top priority to work that is needed to protect trees from serious or immediate damage. Examples might be fencing to exclude livestock, trapping and baiting to control mountain beavers, signing and patrolling to stop seasonal trespass, or burning to abate a slash hazard.

d. Culture a small trial area, say about 1/2 acre. This will permit trying various techniques, comparing tools and equipment, and making time and cost study estimates. Have the trial area examined by a Christmas tree specialist and obtain his suggestions before culturing on a larger scale.

e. Start cultural work where the most production can be accomplished and where the need is the greatest. This is usually where the greatest number of marketable trees can be cultured in the shortest time. However, in some cases, it might be older stands where trees will grow too large unless they are cultured immediately.

f. Plan realistically. Most new growers overestimate what they can accomplish. Estimated acreage that can be can be cultured each year can be computed from total work days that will be available and average per day accomplishment.

2. <u>Hardwood Control, Space Thinning, and Basal Pruning</u>

These 3 practices are the "musts" to develop natural stands for Christmas trees. They are often carried out as a single operation but each requires individual techniques. Most growers do this work during the dormant season, starting in late summer when new growth has hardened off. New growth during the succulent stage is easily damaged. The grower can usually plan to start marketing the trees 2 or 3 years after culturing.

Many growers find that additional cultural practices, which will be described under "pruning and shearing techniques", are also profitable but the following 3 basic practices should be done first.

A WESTERN WASHINGTON TREE FARMER IS CULTURING A NATURAL STAND OF DOUGLAS-FIR SAPLINGS BY REMOVING HARDWOODS, THINNING, BASAL PRUNING, AND SCARRING. A FEW OF THE LARGER TREES IN THE BACKGROUND ARE BEING SAVED FOR SEED TREES TO INSURE FUTURE NATURAL SEEDLINGS.

a. Hardwood control is necessary to reduce competition between Christmas trees and hardwoods for space, moisture, and sunlight. Christmas trees require open light on all sides to develop good form and vigor. Hardwood trees and brush also spread abundant seed and retard reseeding of desirable species. Larger stems are cut with chain saws, power brush cutters, or bow saws. Smaller stems are usually cut with machetes or light axes, which are also good tools for space thinning and basal pruning.

Stump sprouting can be controlled by spraying freshly cut surfaces with chemical brush killers (herbicides) such as: 2,4-D or 2,4,5-T. Pump type oil cans or garden type compressed air sprayers make satisfactory herbicide applicators. They give good spray control for avoiding accidental damage to Christmas trees. Several treatments may be necessary before roots are killed. Cutting down larger hardwood trees and spraying the stumps is a better practice than girdling and leaving them standing. Branches of dead standing trees interfere with small Christmas trees that are growing through them. Also, the dead trees will eventually decay and fall over with risk of damage to Christmas tree growing stock.

Another way to control brush and small hardwood trees is by spraying their leaves with a herbicide, using a pressure type sprayer. This treatment, called foliar spraying, is most effective in June and July. When Christmas trees and brush are so closely intermingled that foliar sprays might accidentally damage the Christmas trees, it is safer to cut the brush and spray the freshly cut stubs.

Control of different species may require different chemicals, concentrations, and techniques of application. Specifications should be obtained from the farm forester or county agent.

b. Space thinning is accomplished by removal of excess coniferous trees in order to give each future Christmas tree room to grow. Christmas

trees need full light from all sides. Crowded trees develop uneven crowns, weak branches, and suppressed foliage on whorls. Most growers strive for an average spacing of 5' which would leave about 1,740 trees per acre. Closer spacing may be utilized where a lower level of smaller trees or seedlings is being developed to replace taller pruned trees that will be cut. A good spacing guide is to allow enough distance between trees to prevent the branches of each tree from contacting or intertwining with those of its neighbors.

Inexperienced growers are more inclined to thin too lightly than too much. They frequently fail to allow extra space for growth expansion when trees require several more years to develop. In both trees the quality suffers when the branches are allowed to grow together. Wind action rubs off needles and causes abrasions, shaded needles and twigs become weak and contorted, and the crowns become lopsided.

Initial thinning often removes more trees than the number retained. This gives the grower a good opportunity to select and save the very best ones for Christmas trees. Selection should be based on natural form, density, limb structure, color, and thrift, as well as proper spacing. Certain trees appear to grow faster than their neighbors and develop an open form. These should be removed in favor of compact, bushy trees that have a natural tendency to shape up well for Christmas trees.

Once started, thinning is a continuing job. It should be repeated as often as necessary to maintain adequate spacing of potential Christmas tree growing stock. Most growers thin their stands at 1 to 3 year intervals and combine thinning with other periodic jobs such as brush cutting and pruning. Periodic thinning removes the following types of unmerchantable trees:

(1) Those growing too close together.

(2) Those that have been cultured, but for some reason fail to develop properly.

(3) Those that have grown too large for Christmas trees and which are not needed for seed trees.

(4) Species that are not in demand.

Harvesting merchantable trees is a form of thinning. Removing marketable 5- to 7-foot trees, together with some crowded smaller trees that are marketable, creates openings in the stand. However, harvesting alone seldom accomplishes the degree of thinning that is needed. Periodic thinning should be planned to remove sufficient additional trees to maintain proper spacing.

Many growers retain 2 or 3 older trees per acre for seed production to insure a perpetual crop of new seedlings to replace trees that are cut. Seed trees should be pruned high to prevent shading of the Christmas trees, but not more than 1/3 of their live limbs should be removed.

Viable seed production usually starts when the tree is about 30 years old. Selected seed trees should be full-crowned and healthy.

c. Basal pruning is the removal of unwanted lower branches between the bottom whorl of the Christmas tree and the ground. Light axes, machetes, and hand pruners are effective tools for this work.

The bottom whorl should be carefully selected because it forms the foundation of the Christmas tree. It is the first good whorl above the general level of the ferns, grass, brush, and other ground cover. The whorl should consist of 4 or more well-formed, evenly spaced branches. It should not be located below serious defects, such as imperfect upper whorls or excessively wide-spaced whorls called "goosenecks". In order to meet these standards, it is sometimes necessary to basal prune to a height of 6' above the ground.

If trees are naturally slow-growing and complete pruning below the basal whorl would be so severe as to shock and stunt the tree, one or more whorls should be left near the ground to support adequate growth. These may be gradually removed as the tree develops additional height and vigor.

THIS GROWER IS IMPROVING THE QUALITY OF A NATURAL CONCOLOR FIR IN EASTERN OREGON BY THINNING AND PARTIAL BASAL PRUNING. HE AVOIDS EXCESSIVE SHOCK TO THESE SLOW GROWING TREES BY REMOVING ONLY 1 OR 2 WHORLS OF BRANCHES BELOW THE BOTTOM WHORL OF THE FUTURE CHRISTMAS TREE.

Fast-growing species, such as Douglas-fir, may need pruning when they are only 3 or 4 years old. Slow growers, such as noble fir, may need only the handle and perhaps 1 whorl just below the handle pruned a few years before cutting. A fuller, better formed basal whorl will develop if the tree is pruned at least 2 years before it is cut.

Basal pruning accomplishes the following for your trees:

(1) Helps control excessive growth. Basal pruning shocks the tree by removing a portion of the needles, which are its food manufacturing plant. It reduces both leader length and branch length growth for several growing seasons. Studies with Douglas-fir, for example, have shown that removing half of the live crown reduced leader growth of most trees about 25% during the first growing season after pruning and about 30% during the second growing season after pruning.* Thereafter, trees gradually recover from the pruning shock and most regain a normal growth rate during the fourth growing season after pruning.**

Ideal annual leader growth for Christmas trees is generally considered 12" to 16". By trial and error, a grower learns to judge the degree of basal pruning that is necessary to maintain

*Coop. Study by Bernard S. Douglass, U.S. Forest Service, Portland, Ore., (1960-1962)

**Study by Joseph Buhaly, Wash. State Ext. Serv., Loran Curry, State of Wash. Dept. of Natural Resources, and John Hultgren, SCS, (1957-1961)

this amount of growth. His judgment in each case is influenced by past culturing experience with similar trees that grew in the same area.

(2) Gives the tree a bushy appearance. Approximately the same number of needles and buds are produced on a branch regardless of its length. When pruning causes a shorter annual branch growth, more needles and buds per inch of branch growth are produced. This gives the tree a more dense, compact appearance.

The bottom whorl needs open light and adequate growing space to stimulate strong branches, healthy needles, and new buds. Basal pruning accomplishes this in 2 ways: It develops the bottom whorl above the level of low brush, ferns, and other ground cover. It also removes competing branches that shade and suppress the inside branches of the bottom whorl.

(3) Forms an adequate handle. Basal pruning should develop a smooth knot-free handle. The handle is defined as the stem of the Christmas tree just below the bottom whorl. Its length is usually 1 1/2" per foot of Christmas tree height. Branches pruned from the handle should be cut flush with the bark to prevent both stubs and large scars.

(4) Clearly indicates the usable portion of the tree. After basal pruning the handles and crowns of the Christmas trees stand out clearly, to guide future cultural work and harvesting operations.

3. Access Roads

A main access road to the Christmas tree area is a basic requirement for culturing and harvesting. It should be constructed to all-weather standards to permit winter use. Existing public roads passing through the area may serve for main access. Private roads may also serve this purpose if they are constructed with moderate grades and adequately surfaced and drained. They have the advantage of controlling access to reduce trespass.

In addition to the main access road, a system of parallel secondary access roads should be constructed throughout the cutting area at 200- to 400-foot intervals. These roads make every portion of the area easily accessible to vehicles and workers. Road construction destroys trees and removes strips of land from production. Road locations should be designated before the area is cultured. This will avoid culturing trees that will be destroyed by road construction.

Another important purpose of roads is fire protection. This is covered under Section E. "PROTECTING THE TREES".

C. DEVELOPING A PLANTATION

1. Matching Species to Site

Most successful Christmas tree plantations have been established on cleared lands recently abandoned from growing agricultural crops. Production of highest quality trees with lowest cultural costs is usually obtained where soil is well drained, easily tilled, and low to medium in fertility. Growth characteristics of native conifers growing near the plantation site should give a clue to future growth rate and survival that can be expected for planted trees.

Slow growing species, such as grand fir, concolor fir, noble fir, shasta red fir, and Spanish strains of Scotch pine are usually best adapted to higher (more productive) sites. High sites generally have plentiful moisture, productive soil, north to east exposures, or other conditions that favor rapid tree growth.

Fast growing species such as Douglas-fir, shore pine, and most other pines usually develop best for Christmas trees on lower (less productive) sites where limited moisture, less fertile soils, climatic extremes, or southto west exposures cause relatively slow tree growth. Proper matching of species to site is one of the most important decisions for establishing a successful plantation. This subject is discussed in detail in bulletin #4 of this series "Selecting a Good Area to Grow Christmas Trees in the Pacific Northwest". Growers should consult a forester to determine which species are best adapted to their particular planting sites. Planting 2 or more species is usually a good practice. It spreads the risk of loss from insects or disease that are partial to a particular species. It also enables the grower to determine which species are best adapted to his planting site and to supply a wider market demand.

2. Jobs Preliminary to Planting

At this point it is assumed that the grower has selected a good plantation site and knows what species to grow. He is now ready to start his planting program. The following jobs should be done well ahead of planting:

a. Ground should be plowed, disced, and harrowed before planting. Summer fallowing is necessary on old fields or pastures where heavy sod has formed. Newly planted trees cannot survive competition for moisture and light with a heavy growth of grass and weeds. This problem is greatest on better agricultural soils.

Another reason for eliminating grass and weed cover before planting is to destroy the natural habitat of rodents. Mice and rabbits sometimes wipe out entire plantations by girdling and nipping small trees. Grass and weeds also cause a build-up of root-eating pests such as gophers and June beetle larvae. Plowing and fallowing causes them to starve or move out of the area.

b. Planting stock should be ordered well in advance of planting and arrangements made for delivery just prior to planting.

Seedlings can be purchased from State Nurseries, c/o Oregon State Board of Forestry, Salem, Oregon, or c/o State of Washington, Department of Natural Resources, Olympia, Washington. They may also be purchased from various private tree nurseries, some of which specialize in Christmas tree stock.

c. Seedlings are packed in tight bundles at the nursery for convenience during shipment. Wet shingle tow, moss or other absorbent material is placed around the roots to protect them from drying. Water should always be poured through the bundles as soon as they arrive to replenish moisture lost during shipment. Bundles should be stored outdoors in a cool, protected spot.

Unless trees are planted within 2 or 3 days after delivery they should be removed from the bundle and heeled in where there is sufficient moisture, shade, and protection from drying winds. Instructions for this operation are enclosed with the bundle.

d. Some plantation owners have improved growth rate and survival by planting larger sized stock called "transplants". Nurseries that handle transplants sell them for about twice the cost of regular 2-year old seedlings. Where nursery-grown transplants are unavailable, they can be developed in home transplant beds from regular 2-year old nursery seedlings.

Instructions for growing transplants follow:

Select a transplant bed with the same care as used in selecting a good garden spot. Plant the seedlings 2" or 3" apart in rows. Space the rows 6" to 18" apart, depending on the type of cultivation equipment that is used. Water the transplant beds regularly during dry periods and control grass and weeds by shallow cultivation, chemicals, or surface mulching with 2" or 3" of sawdust or similar material. (If sawdust becomes mixed with the soil, it causes a loss of nitorgen. A nitroen fertilizer must then be added to the soil to restore its productivity.) After 1 or 2 growing seasons, lift the transplants from the beds and plant them permanently in the field. Growers should consider purchasing or growing transplants when husky planting stock is needed to overcome competing vegetation and drought conditions. Some of the successful growers who specialize in grand, noble, concolor, and other true firs have found that better survival of transplants more than justifies the added costs.

3. Planting Techniques

Planting requires special techniques for good survival. The local forester should be consulted. Early spring planting is usually more successful than fall planting, especially on heavy soils that are subject to frost heaving. Small acreages are usually planted by hand using a planting hoe, planting bar or shovel. One man can plant 500 to 1,000 trees per day. On larger areas, it may be cheaper to use a tractor-drawn planting machine which can plant 10 times faster than by hand. These machines are available on either a rental or contract planting basis.

Recommended spacing to grow the popular 5-, 6-, and 7-foot tall trees is 5'x5'. Although some growers prefer to plant 6'x6' to facilitate cultivating and mowing with wider equipment, this width of spacing reduces the number of trees per acre and is not actually needed to prevent crowding. A few growers start out with 3'x3' spacing and remove every other tree when it reaches table tree size. Planting in perfect squares is recommended to permit cross-cultivating and cross-mowing. This is accomplished by scoring the ground lightly in two directions before planting to mark out a square grid for a guide. Number of trees per acre for various spacing are shown below:

3'x3' = 4,840	6'x6' = 1,200
5'x5' = 1,740	8'x8' = 680

Loss of planted trees is greatest during the first year after planting. Survival of more than 95% has been experienced under very favorable conditions. On the other hand, survival of less than 50% is not unusual on very severe, soddy, or rodent infested sites. Retaining some trees in a transplant bed will provide a handy source of planting stock to replace dead trees.

Each species should be planted in separate areas rather than intermingling them or alternating the rows.

Faster growing species are apt to crowd out the slower species in mixed plantings. Mixing species also complicates cultural work and harvesting operations.

4. Weed and Grass Control

Shallow cultivation is the usual method for controlling grass and weed competition. It is particularly important during the first spring and summer after planting. It should be repeated whenever grass and weeds become reestablished.

THIS CHRISTMAS TREE PLANTATION HAS BEEN CULTIVATED FOR 2 YEARS TO ELIMINATE GRASS AND WEEDS. AFTER THE SECOND OR THIRD YEAR OF CULTIVATION, GRASS AND WEEDS MAY BE CONTROLLED BY MOWING.

Substitutes for cultivation have been tried with varying success. Spraying the plantation with selective chemical weed and grass killers is a new and very promising development. When applied in proper concentrations some chemicals will not damage the trees. Best results have been obtained by spraying cultivated, newly planted ground during April or May just before weed and grass sprouts begin to emerge. The farm forester or county agent should be consulted to determine the most effective chemicals, formulas and methods of application.

Another method of grass and weed control is to apply a mulch around individual trees. Good tree survival on hot, dry sites has been obtained by using durable kraft paper cut in 2' x 2' sheets with an "X" sliced in the center. These are slipped over the top of the tree and weighted down by piling earth along the edges. Black polyethylene sheets and sawdust and other types of mulching piled around the stems have been used with varying degrees of success. Growers should compare costs and make small scale trials to compare effectiveness of various types of chemicals and mulches before making large scale applications. Two or 3 years after planting, when the trees have become well established, mowing may be substituted for cultivating to control grass and weeds. Rotary or reel type mowers that chop the vegetation finely are preferred by most Christmas tree growers. The resulting mulch decays rapidly and most of the fire hazard and rodent habitat is eliminated.

Mowing benefits the plantation by reducing root competition, eliminating shade from the lower branches, reducing fire hazard caused by dry standing grass and weeds, and removing the cover for rodents. Some growers dispense with mowing on sites where grass and weed cover is naturally light or can be controlled with chamicals. If a plantation is not mowed the following precautions should be taken:

a. Firebreaks should be constructed by plowing strips or maintaining a network of roads that are free of grass and weeds.

b. Trees should be basal pruned sufficiently high to prevent severe shading and suppression of the lower branches by grass and weeds.

c. Close observation is necessary to prevent a build-up of rodents, especially meadow mice. Baiting, trapping, or repellents may be necessary.

THIS NOBLE FIR WAS PRUNED TOO LATE. EXCESSIVE LEADER GROWTH DURING THE LAST 2 GROWING SEASONS COULD HAVE BEEN PREVENTED 3 YEARS AGO BY PRUNING OFF A FEW BOTTOM WHORLS TO SHOCK THE TREE. FURTHER SHOCKING, IF NECESSARY, COULD HAVE BEEN ACCOMPLISHED BY SCARRING.

5. Basal Pruning

Basal pruning of natural stands has already been discussed. The same principles apply to basal pruning of plantation trees. The selected bottom whorl should be located at least 9" to 12" above the ground to permit an adequate handle and, in any event, above heavy shade caused by grass and weeds.

Pruning planted trees too early stunts their growth and reduces their general vigor and ability to withstand drought and competition. Therefore, it is advisable to postpone any trimming of branches, except removing multiple leaders, until indications first show that next year's leader growth will exceed 14" in length. However, it is equally important to basal prune in time to help retard excessive leader growth.

6. Adequate Moisture

Natural moisture conditions west of the Cascades are usually sufficient for established trees. However, newly planted trees are frequently killed by prolonged summer drought. Grand, noble, concolor, and other true firs are much more susceptible than pines. Douglas-fir is intermediate in drought resistance. Sprinkling, flood irrigation, or watering individual trees during dry periods will save many of them. Drought susceptible species can also be helped by planting on north and east exposures, clean cultivating, mulching, and inserting a shingle for shade on the southwest side of newly planted seedlings.

D. ADDITIONAL CULTURAL TECHNIQUES

The following cultural practices may be applied to either cultured natural stands or plantations:

1. Crown Pruning

Crown pruning consists of the removal of unwanted branches in the crown of the Christmas tree. Some crown pruning practices are:

a. Removal of multiple leaders. When the top of a tree produces 2 or more leaders, all but the best one should be cut off close to the main stem. Multiple leaders are produced when the terminal bud or leader is broken off or injured. They also develop on some small seedlings.

b. Removal of suckers. Suckers are formed by lateral branches or large sprouts that turn upward along the side of the stem. They conflict with the horizontal pattern of normal branches and should be cut off close to the stem.

c. Removal of unwanted branches. Any branches that do not conform with the desired shape, symmetry, or density of the tree should be removed or cut back. Examples are branch tips that are abnormally long or those that turn back toward the main stem of the tree.

2. Scarring

This is a means of slowing growth rate by intentionally injuring the cambium layer under the bark to cause shock. Trees should never be scarred unless excessive growth threatens to become a problem. The principal purpose of scarring is to reduce the growth rate of trees that have recovered from the retarding effects of basal pruning. It may also be done at the same time as basal pruning on fast growing trees when growth would not be sufficiently retarded by basal pruning alone.

a. Basal scarring is the most frequently practiced type of scarring. A strip of bark 4" to 12" long is skinned off the lower stem with an axe, machete, or knife. The scar should be 9" or more below the bottom whorl to avoid disfiguring the handle. Sufficient pruned stem length for scarring, as well as forming a handle, should be considered when basal pruning.

Scarring may be done at the time of basal pruning or at any other time that excessive height-growth becomes a problem. The more severe the scarring, the more pronounced will be the next season's growth reduction. Heavy scarring is 6" to 12" long and girdles the stem circumference, a maximum of about 60%. Light scarring is only 3" to 6" long and girdles the stem about 20%.

b. Leader scarring is a less frequently used method of scarring in which 1 or 2 strips of bark are sliced from the base of the leader. Care must be taken not to slice too deeply as this may weaken the leader and cause breakage. This type of scarring may reduce next year's leader growth, but does not slow the growth of lateral branches below the scar. Some growers have obtained good results with this technique. Others, especially those culturing trees on fast-growing sites, have been unable to check excessive leader growth.

3. Leader Pruning Firs and Spruces

Leader pruning consists of cutting back excessively long leaders to proper lengths. If this is not done, wide growth intervals called "goosenecks" are formed between the whorls.

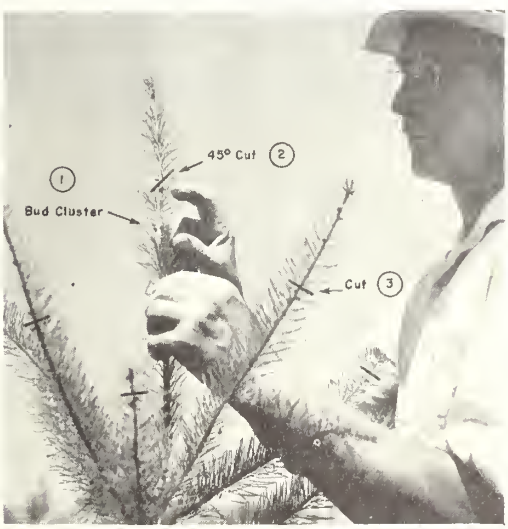
These are a major cause of skimpy, poor quality trees. Leader pruning is also used to arrest height growth of fast growing trees and force internodal branches to fill in the goosenecks. Tips of main lateral branches should be sheared back at the same time to prevent multiple leaders and to restore a uniform taper.

A few problems may result from leader pruning. Although not always serious, they should be anticipated by a grower who plans to do this work. First, he should realize that false whorls are seldom as symmetrical as true whorls formed at the tips of unpruned leaders. A small crook or "dogleg" will form on the new leader just above the cut. Leader pruning, together with the necessary branch shearing, is more costly and painstaking than preventing excessive leader growth by basal pruning and scarring. For these reasons many growers prefer to prevent, rather than correct, excessive leader growth.

Unlike pruned leaders of pines, which will form a new cluster of buds just below the point of cutting, pruned leaders of firs and spruces must develop new growth from existing internodal buds at intervals along the stem. Two very exacting techniques have been developed to correct excessively long leaders on firs and spruces without causing multiple leaders or unsymmetrical whorls of branches.

a. Forming a false whorl.

A cluster of 4 or more evenly distributed internodal buds is selected on the leader at a point 12" to 16" above the top whorl. It is not necessary that all the buds in the cluster arise from the same level on the leader--they may be scattered over a span of 2" or 3". Next, a single strong internodal bud is selected at least 2 1/2" above the bud cluster. Any additional buds



TECHNIQUE FOR FORMING A FALSE WHORL IS ILLUSTRATED ABOVE.

1. LOCATE A CLUSTER OF 4 OR 5 BUDS APPROXIMATELY 12" TO 16" ABOVE THE TOP WHORL.
2. CUT THE LEADER 1/8" ABOVE A STRONG SINGLE BUD LOCATED 3" OR 4" ABOVE THE CLUSTER. REMOVE ANY SURPLUS BUDS BETWEEN 1 AND 2.
3. CUT BACK THE BRANCH TIPS OF THE TOP WHORL ABOUT 1/8" ABOVE A PAIR OF BUDS.

THE FALSE WHORL SHOWN ABOVE WAS PRODUCED DURING THE FIRST GROWING SEASON AFTER TREATMENT. THE SCAR WHERE THE LEADER WAS CUT IS BEING POINTED OUT.

between the bud cluster and the top bud are picked off to discourage the formation of multiple leaders. A pocket knife or hand pruner is used to cut off the leader at a 45° slant, leaving the single top bud 1/8" below the high point of the cut. This bud forms next year's leader and the cluster of buds below it will develop into lateral branches which simulate a true whorl.

At the same time the leader is pruned, the branch tips of the top whorl should be either disbudded or sheared back a few inches above a pair of buds. This will keep the branches from turning up to form multiple leaders. It will also keep the width of the tree in good balance, since the branches of a false whorl grow only about 2/3 as long as those of a true whorl during the first year.

b. Succulent leader pruning followed by regrowth.

Succulent leader pruning is accomplished by cutting off the top of the leader during early summer when the new growth is still tender. This work is begun in about June when the new leader shoot has barely completed its growth. Since the succulent stage lasts for only a few weeks, this work must be completed during that period to be successful.

The tender leader should be cut off just above a lone internodal bud in a manner similar to that described for forming a false whorl during the dormant season. Internodal buds appear as tiny scales during the succulent stage and are somewhat difficult to see. About 50% of the time a short sprout of regrowth called a lammas shoot, will form during late summer from the top bud just below the cut. This regrowth is essential to make the system work, since it produces normal terminal buds like those on an unpruned leader. By selecting the proper pruning length and allowing an inch or two for the regrowth sprout, it is sometimes possible to obtain desired spacing between whorls.

However, a good precaution is to leave a bud cluster a few inches below the cut when succulent shearing. This will permit development of a false whorl in those cases where a regrowth sprout does not occur.

THE POINT IS INDICATED WHERE A DOUGLAS-FIR LEADER WAS PRUNED 3 MONTHS EARLIER DURING ITS SUCCULENT STAGE OF GROWTH. DURING THE SUMMER A REGROWTH SPROUT FORMED FROM A BUD JUST BELOW THE CUT. THE TIP CONTAINS A PERFECT BUD CLUSTER TO FORM NEXT YEARS LEADER AND BRANCH WHORL.

4. Shearing Firs and Spruces.

Shearing is the practice of cutting back the tips of lateral branches. It stimulates bud production and results in greater density of foliage. It is also used to narrow the taper of excessively wide trees and to make lopsided trees more symmtrical. Some growers have produced good quality in fast-growing trees by a combination of leader pruning and shearing the laterals to allow the internodal branches to fill in the spaces between the whorls.

Many growers have found that shearing is one of the most important cultural practices to produce high quality trees. Other successful growers who work with different species or under different growing conditions have found that shearing does not pay. If trees are naturally slow-growing, well-shaped, bushy, and compact, shearing would do little to improve them.

Two methods of shearing are practiced on firs and spruces.

a. Random shearing is the shaping of a tree with a hedge shears or long-bladed knife to a uniform cone. Most trees are shaped so that the spread of the lower whorl is 3/4 of the tree height, a taper of 75%. Taper may vary from 50% to 100%, depending on species and consumer preference. After shearing, new branches develop from internodal buds along the stem. They will conceal the stubs after about 2 growing seasons. Most growers do this type of shearing during the dormant season but a few growers shear during the succulent period when knife shearing is most efficient and resulting stubs are less noticeable. Very severe or frequent random shearing causes trees to become extremely heavy, dense and hedge-like. At present the demand is greater for light to moderately sheared trees, which are more natural in appearance.

The greatest advantage of random shearing is low cost and simplicity. The disadvantages are that 2 growing seasons are required to hide the stubs and the branches lack symmetry.

b. Fork shearing is the removal of last year's growth tip from lateral branches to arrest lateral growth and force growth of secondary branches. The cuts should be made very close between the branch forks to prevent a visible stub. Branches sheared in this manner become attractive and fan-shaped when the lateral branches develop new growth. Since the top whorl is unbranched and cannot be fork sheared, the terminal bud on each branch should be picked off to prevent a flared top and preserve an even taper.

Fork shearing can be used effectively to correct lopsided trees. Symmetrical shape can be obtained by fork shearing to remove 1 or 2 year's growth tips on the wide side of the tree and only disbudding or not working the narrow side. Fork shearing is also useful to narrow the taper of excessively wide trees, such as some grand firs. As much as 2 or 3 years of unwanted growth can be removed from the ends of abnormally long branches if care is used to prevent stubs.

FORK SHEARING PRODUCED THIS ATTRACTIVE, FAN-SHAPED BRANCH. A SMALL SCAR IS SHOWN WHERE THE BRANCH TIP WAS CUT 2 YEARS AGO TO ARREST EXCESSIVE LATERAL GROWTH AND TO PROMOTE A DENSER BRANCH STRUCTURE.

Cost of fork shearing exceeds that of random shearing, but may be justified by the neat, symmetrical appearance and the opportunity to market the tree after only one season's growth.

5. Disbudding firs and spruces

Disbudding is the practice of pinching off the terminal, or middle bud, from the bud cluster at the tip of main lateral branches. (The terminal bud on the tip of a leader should never be removed, since this would cause multiple leaders to form.) Branch growth resulting from disbudding is quite similar to that of fork shearing. It prevents the growth of the main branch tip and allows 2 or more secondary branches to form on each lateral. Lateral growth is slowed down and growth of secondary (internodal) branches is stimulated. Irregular shape of trees can be corrected by using a combination of fork shearing and disbudding.

6. Shearing Pines

Shearing of pines includes cutting back both the leaders and lateral branches in a single operation. It is widely practiced in the Lake and Eastern States to improve shape and density. Shearing of pines is beginning to gain acceptance in the Pacific Northwest, particularly when a dense type of tree is desired. It should be started when, but not before, natural leader growth exceeds about 14". In natural areas, this stage of development usually occurs when trees are 2' to 4' in height. In plantations, it usually occurs during the third growing season after planting. Pines should be sheared only during the succulent stage from about June 15 to July 15. Shearing should begin when elongation of the succulent growing tips (candles) is nearly complete and the new needles are about half elongated. Shearing should stop when the new succulent growth begins to harden off and bud formation is no longer dependable. In about 6 weeks, tips of branches sheared during the succulent stage will form complete new bud clusters at the base of needles.

PINES HAVE THE UNIQUE ABILITY TO PRODUCE COMPLETE NEW BUD CLUSTERS ON TIPS OF BRANCHES AND LEADERS THAT ARE SHEARED DURING THE SUCCULENT STAGE OF GROWTH. THE ABOVE BUDS FORMED DURING LATE SUMMER ON A PONDEROSA PINE LEADER THAT WAS PRUNED BACK IN JUNE. THE SCAR IS VISIBLE WHERE THE LEADER WAS CUT ON A 45° ANGLE.

Recommended succulent shearing techniques for pines are as follows: Using either a hedge shears or a long, thin breadknife, the leader is cut off on a 45° angle to a sheared length of about 14". Next, the top whorl is sheared to about half the length of the leader, or about 7". Some growers gather all the branches of the top whorl together in one hand, pull them upward, and cut them to the same length with a single knife cut. Others shear the branches individually. In either case, the lower laterals should be sheared back as part of the same operation to form a near perfect cone with a taper of 60% to 70%. Shearing once started should be continued each year

during the succulent stage. If multiple leaders form, all except the best one should be either removed or sheared to the same length as the laterals. The last shearing before the tree is cut should be done lightly and skillfully to prevent visible stubs and a cropped appearance.

THIS SHORE PINE HAS COMPLETED ITS THIRD GROWING SEASON IN THE PLANTATION. IT IS READY FOR ITS FIRST SHEARING, AS INDICATED BY A LEADER GROWTH OF MORE THAN 14". IF THE TREE IS NOT SHEARED AT THIS TIME, IT WILL NOT DEVELOP A COMPACT BRANCH STRUCTURE.

THE SAME TREE IS SHOWN AFTER SUCCULENT SHEARING WITH A SHARP BREAD KNIFE. THE LEADER WAS CUT BACK TO 14" AND THE TOP WHORL TO 7". TIPS OF REMAINING LATERAL BRANCHES WERE TRIMMED TO DEVELOP A CONICAL SHAPED TREE.

7. Root Pruning

Root pruning has been used by nurserymen for many years to slow growth and develop compact roots on ornamentals. Perhaps certain applications of root pruning, such as cutting the shallow feeder roots, might be used to control the growth of Christmas trees. To test this possibility, a few studies* were made to observe the response of 3' - 10' tall Douglas-firs to root pruning. Some trees were root pruned to the depth of a shovel blade in a complete circle around the tree 2/3 of the distance from the stem to the drip line. Others were root pruned in a similar manner, but on only 2 sides of the tree. This would simulate root cutting by a coulter or ripper operated between plantation rows.

*Leader Growth Control Studies for Douglas-fir Christmas Trees, by B. S. Douglass, U.S. Forest Service (1960)

Root pruning in a complete circle caused too drastic shock for most trees, as evidenced by chlorosis (yellowing of the needles) and excessive stunting (more than 50% growth reduction). Trees that were root pruned on only 2 sides responded much better. Growth rate was reduced only about 25% and few trees showed discoloration.

Root pruning should be limited to small scale trials until it is more thoroughly tested. More information is needed in techniques and growth response, particularly on fast growing plantations where root pruning appears to offer possibilities.

8. Stump Culture

Stump culture is the practice of developing a new Christmas tree from a limb or sprout left on the stump after a Christmas tree has been cut. To make this system work, several strong branches or sprouts should be left on the stem below the handle. A year or two after the tree is cut, they will turn upward and form multiple leaders. The most promising one is then selected to produce a new tree. Remaining branches are pruned back or removed to reduce competition. Some growers have produced 3 or 4 successive Christmas trees from a single stump.

Pines are the most dependable for producing a new tree from a turned up limb.

The results for Douglas-fir are variable. Sometimes a lower limb will develop properly, but more reliable results are usually obtained from a newly formed sprout.

True firs, such as grand, concolor, and noble, are very reluctant to form a new tree from an upturned branch. Much better results for these species are obtained by developing a newly formed stump sprout. A few lower limbs are left on the stump, as with other species, but their only purpose is to sustain the vigor of the root system until a sprout is produced.

For all species, shock to the root system can be reduced and the develop ment period for a new tree can be shortened by "training" a branch or sprout for several years before the tree is cut.

Since stump cultures usually do not shape up as reliably as natural trees they are more often grown by necessit than by choice. Few growers bother with stump cultures in cultured natural stands where natural seedling are plentiful. However, some situations favor growing stump cultures. These include areas where survival conditions for planted seedlings are poor or where natural seedlings are scarce. Other possible advantages are the creation of mixed-age stands from even-aged plantations or the perpetuation of Christmas tree production from trees having superior genetic characteristics.

9. Fertilizing

Fertilization is a relatively new cultural aid. It is used to improve color, luster, and density of needles and to increase growth rate of leaders and branches. Slow growing trees with light, off-color needles and weak branches are most likely to benefit. Such trees are most frequently the result of low fertilit and summer drought.

Fertilizers must be used with caution On some sites they may do more harm than good by causing trees to grow too fast or by stimulating rapid growth of competing vegetation. Large scale applications should not be made until sufficient small trials have proven the effectiveness of the application under local conditions. Nitrogen fertilizers have proven more beneficial to Christmas trees in most parts of the Pacific Northwest than mixed fertilizers which also contain

phosphate and potash. Urea (46% nitrogen) is a very concentrated form of nitrogen fertilizer. Other nitrogen fertilizers are ammonium nitrate (33% nitrogen) and ammonium sulphate (20% nitrogen). The County Agent can assist in determining the correct amount of any nitrogen fertilizer to apply to obtain a desired amount of available nitrogen. For example 1.09 lbs. of urea fertilizer is required to provide 1/2 lbs. of nitrogen.

Fertilizers have 2 purposes, both of which require separate techniques. Instructions follow:

a. Improving color without stimulating growth.

Fertilize after early summer growth has stopped but before fall rains begin. This is usually between mid-June and mid-August. Either urea or ammonium nitrate is effective where the fertilizer is applied in late summer just before fall rains begin. Ammonium nitrate is recommended for early or mid-summer applications because it does not deteriorate under long time surface exposure prior to leaching into the ground.

Fertilize only those trees that you plan to cut for the Christmas season following the fertilizer application. Fertilizer should be scattered evenly under the drip line. The tree will pick up sufficient nitrogen after the first rains to develop a dark green color. Nitrogen requirements will vary with site, species, and tree size. Trial spreads of 1/16 to 1/2 lbs. (nitrogen weight) per tree should be made to determine the least amount that will give good color.*

b. Improving both color and growth rate

Fertilize in early spring when buds first begin to swell, usually in April. Much of the nitrogen is leached out of the soil when fertilizer is applied earlier during the dormant season. If the ground is relatively free of heavy fern, salal, grass, and other competing vegetation, broadcast the fertilizer evenly under the drip lines of the trees. Where heavy competing vegetation does occur, fertilizer may be applied in 3 or more evenly spaced piles about half way between the stem and the drip line. This will help reduce the take-up of nitrogen by other plants.

When trees are fertilized in the spring, they will respond during the first growing season. Increased growth and heavy, dense, dark green needles will occur. This stimulation continues after the original fertilizing for several additional growing seasons. Experiments in a Douglas-fir Christmas tree area near Shelton, Washington caused increased leader growth of more than 25% during the first growing season after fertilizing and nearly 100% during the second growing season.*

Similar experiments on a very slow growing site on the Kitsap Peninsula in Washington produced increased leader growth after the first growing season of about 100%, with a nitrogen spread of 200 lbs. per acre, which was the minimum amount that gave good color.**

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*S. P. Gessel, J. W. Duffield, and R. K. Campbell, University of Washington, Results of Christmas Tree Fertilizer Experiment (1955) (Unpublished)

*Wm. Looney, Simpson Timber Co. (1959-1961)

**Dino Sivo, Joseph Buhaly, and Dr. C. B. Harsten, Washington State University (March 1961-not concluded)

On this adverse site, where additional color and growth were both needed, the first year's results were very satisfactory. However, where existing growth is adequate, fertilizing may cause excessive growth unless the trees are harvested during the first Christmas season after fertilizing. The amount of fertilizer needed to obtain desired color and growth response will vary with site, species, and tree size. Only trial and error will establish the correct amounts for each area.

Suggested trial spreads for broadcasting are 100, 200, 300, and 400 lbs. of nitrogen per acre. Suggested trial applications for individual trees are 1/8, 1/4, 3/8, and 1/2 lbs. of nitrogen per tree. Single tree application on the Kitsap Peninsula in Washington produced dark green color with as little as 1/4 lb. of nitrogen per tree.*

E. PROTECTING THE TREES

1. Animals

Livestock should be excluded from Christmas tree growing areas. A good fence provides protection against browsing and trampling by cattle, sheep, goats, and horses.

Deer are frequently a serious problem, particularly where they become too numerous for available supplies of the more palatable types of forage. Leaders and branch tips deformed by deer can be identified by ragged or stringy breaks where the twigs have been browsed. In certain areas, elk produce a similar type of damage. (Rabbits, mountain beaver, and other rodents clip off the branches with clean cuts made at an angle.)

*Darrell Turner and Joseph Buhaly, Washington State University (May 1961-not concluded)

Deer also scrape off bark and break branches by rubbing the trees with their antlers. If deer become a serious problem, the State Game Department may be able to reduce the deer population by extending hunting seasons or issuing special control-hunt permits. High, deer-proof fences are effective, but they are costly to construct and maintain. Several spray-type deer and rodent repellents are available. However, these lose their effectiveness when trees put on a new season's growth and are costly to apply on larger trees.

Rodents are enemy No. 1 to many growers. Meadow mice are particularly troublesome in grassy plantations. They girdle small trees close to the ground. Several weeks or even months may pass before needles of girdled trees turn brown and the grower becomes aware of the extent of the damage. The most effective control is to destroy the mouse habitat by removing grass and weeds from around the base of the trees. Where habitat control is impractical, water-proof bait stations should be set out at about 40 foot intervals.

Rabbits and mountain beaver cause serious damage in some areas by clipping branches. Three methods are used for control:

a. Baiting.
b. Trapping.
c. Altering the habitat.

Habitat can be altered by clearing or burning log piles, slash accumulations, brush patches, and other protective cover in the area.

Pocket gophers sometimes gnaw and girdle tree roots, causing the tree to die or tip over. This problem most frequently occurs in plantations that are established in old fields. The most effective controls are:

a. Elimination of the fleshy weeds on which gophers feed.
b. Trapping.
c. Underground baiting.

Information on the identification and control of rodents may be obtained from the Farm Forester or County Extension Agent.

2. Insects and Diseases

Light and spotty occurrence of insects and diseases is a normal condition on most Christmas tree operations. This condition should not cause alarm. However, growers should constantly be alert for any signs that an insect or disease is starting to get out of control. Danger signs are loss of vigor, dropping or discoloration of needles, webs, spittle, deformed or dying shoots, unusual build-up of insects, and visible fungi fruiting bodies.

Prompt control measures may be necessary to prevent a costly epidemic. The longer you delay, the more costly and difficult control may become.

Frequently, the outward signs of insect and disease damage are quite similar. The first step to take when a build-up occurs is to have the disease or insect identified. Growers should consult with the Farm Forester; County Agent; or Section of Insect and Disease Control, U.S. Forest Service, P.O. Box 4137, Portland 8, Oregon. These people can help growers identify the cause of trouble and recommend methods to control the responsible insects or diseases.

a. Insects

Certain insects, such as white grubs and root weevils, attack the roots of trees. Aphids, spider mites, bud worms, tip moths, wooly aphids, scales, needle miners and caterpillars attack the buds and needles. Twig weevils burrow into the pith and kill shoots or small branches.

Usually insects attack only occasional trees and cause a lowering of Christmas tree grade rather than outright culling. However, a sudden increase in the number of insects is a real danger signal. Most insects can be controlled by application of an insecticide. Cost of controlling insects is usually small compared with the value of trees that might be lost during an epidemic.

b. Diseases

The most common disease to Douglas-fir Christmas trees is "needle cast disease" (Rhabdocline). This fungus causes needles to turn brown and drop off prematurely. Individual trees vary in natural resistance. Those that become lightly infected in ordinary years will likely become badly defoliated during years favorable for the spread of the disease. Control measures consist principally of removing noticeably infected trees. Some growers report that fertilizing increases the resistance of their trees to infection.

A form of blister rust "Western gall rust" causes cankered swellings on the branches of lodgepole and shore pines. Orange spores develop on some of the swollen areas. The cankers eventually girdle and kill the branch. The best control measure is to cut out infected branches or harvest merchantable infected trees before the branches die. A similar but more deadly

disease "white pine blister rust" attacks white and other 5-needle pines. Control with antibiotics is possible, but difficult and costly. Production of 5-needle pines in most areas in the Pacific Northwest may be a poor risk for Christmas tree growers.

Other diseases are usually of relatively minor importance. Root diseases occasionally kill small groups of trees. Certain needle cast, needle rust, and twig blight diseases may cause needles of true firs and pines to die and shed prematurely. These diseases are found most frequently on crowded and suppressed trees. Thinning and removal of badly infected trees will increase the vitality and resistance of remaining trees.

3. Fire

An uncontrolled fire can destroy years of hard work and investment in just a few hours. Adequate fire precautions are one of the best insurance investments that a Christmas tree grower can make.

Both cultured natural areas and plantations have fire problems. However, the hazard is usually greater for natural areas where accumulations of slash, brush, rotten logs, and other flammable debris are the rule. Grass fires are the main fire problem on plantations. Fire prevention and control for both types of operations will be considered separately:

a. Cultured natural areas

The most effective fire control measure is a network of access roads through the area. Roads provide effective firebreaks to help confine fires to a small area. They also permit quick access for fire fighters and fire fighting equipment. In order to remain effective as firebreaks, roads should be bladed regularly to keep them free of ferns and other flammable debris.

Roads have little value as firebreaks unless snags are felled. Burning snags throw sparks which cause rapid spread of fire and may easily be blown across firebreaks by winds and drafts. Roads can also be made more effective as firebreaks by burning adjacent heavy slash concentrations during safe periods. Burning permits from the district warden are required during most of the year.

Some Christmas tree areas are too steep to construct vehicle access roads directly up the slope. In this case, a system of well-drained fire trails might be needed around steep portions of the perimeter or between upper and lower levels of access roads.

Culturing creates a fire hazard from pruned branches, thinnings, and cut hardwoods. Piling and burning slash concentrations on the entire area is desirable but usually the cost of doing this is prohibitive. As a minimum compromise, growers should pile and burn in strips along the main firebreaks. Elsewhere, they should lop the limbs from felled trees so the slash will be close to the ground. This will hasten its decay.

Posting of lands against trespass and controlling access over private roads may prevent some man-caused fires. It also reduces the chance of tree theft.

Growers can facilitate fire suppression by providing a cache of fire tools in a central location. Water holes and ponds may also be developed for an emergency water supply.

If a fire does occur, it should be reported immediately to the State District Warden or District Administrator. In farm areas not covered by State fire protection, the Rural Fire District Headquarters should be notified.

b. Plantations

Dry grass and weeds are the greatest fire threat to plantations during late summer and fall. Prolonged dry periods during winter and early spring also cause flammable conditions.

The best precaution is the elimination of grass and weeds by cultivating, mowing, or by application of chemical grass and weed killers. Where this cannot be done, firebreaks should be plowed or disced to expose mineral soil. They should be constructed along unprotected portions of the perimeter of the plantation, along public roads where man-caused fires are most apt to occur, and through the plantation to divide it into smaller units for easier control of fires. Grass and weed fires spread rapidly and require fast action to control them. Plows or discs, if readily available, can be used to construct a line around fires. Small fires can often be controlled by beating them out with wet burlap sacks, flat shovels, or even a flail made from a heavy evergreen branch.

4. Trespass

Tree theft is a seasonal problem which occurs during 2 or 3 months before every Christmas. This problem is less troublesome when the Christmas trees are growing on your home property and can be watched. The best solution for absentee owners is to establish the operation on a private road with controlled access. Where this is not possible, signs, fences, and locked gates are inexpensive and usually effective precautions. Growers should also obtain the cooperation of neighbors and local law enforcement officials who can help watch for trespassers. More costly precautions such as a hired watchman or special fencing may be necessary in problem areas. The theft of trees is gradually becoming less frequent because of a growing public awareness of private property status of Christmas trees and penalties for violation of State and County trespass laws. The press, radio and television, as well as public and private forestry organizations, are doing a good job of informing the people about the laws and regulations. Law enforcement agencies are also cooperating by checking and investigating violations.

F. IMPROVED TREE STRAINS

Geneticists and nurserymen are seeking better Christmas tree strains for tomorrow's growers. Just as ornamental shrubs with special desired characteristics were developed from the original wild plants, superior Christmas trees will eventually be developed from selected natural trees. Two major aims of the genetic improvement of Christmas trees are greater beauty and "self-shaping" to eliminate a great deal of costly cultural work. Needless to say, tree strains that produce good timber do not necessarily produce the best Christmas trees. Improvement of Northwest species for better Christmas trees is still in its infancy.

Scotch pine has received somewhat more attention than native species. This species grows naturally over most of Western Europe. Its great geographical variation in needle color and length, growth rate, branching habit and other inherited characteristics have been intensively

studied. The Southern European French Auvergne and Spanish strains with short blue-green needles are in greatest demand. Reliable Christmas tree nurserymen indicate the strains or characteristics of their planting stock. Some nurserymen collect their own seed from desirable parent trees to insure a reliable seed source.

Occasional individual Douglas-fir, noble fir, grand fir, concolor fir, shore pine, and other native Christmas trees are found with near-perfect symmetry, density, growth rate, and color characteristics. Such desired trees may be propogated vegetatively in several ways:

1. Stump culture.
2. Grafting cuttings on rootstocks of ordinary trees of the same species.
3. Rooting of cuttings.

All of these practices preserve the characteristics without change. Growers who find these rare trees are advised to save them for future production and breeding work.

Some interest has also been shown concerning the development of seed orchards in which cuttings from desirable parent trees are grafted for cross-pollination and seed production. However, seed orchards are costly to establish and the resulting seeds require thorough testing to assure that the grafts breed true to type. While perhaps many years away, this method of seed production may eventually offer opportunities for improved planting stock.

G. SOURCES OF ASSISTANCE AND INFORMATION

Services of a farm forester are available to most woodland areas in Oregon and Washington. The office address of the local farm forester can be obtained by inquiring at any State Forestry Department office in Oregon or State Department of Natural Resources' office in Washington.

Reference material is available from the County Extension Agent. He can also advise growers concerning the availability of assistance from farm foresters, extension foresters and others who work with Christmas tree growers.

Additional sources of Christmas tree culturing information are:

Extension Forester
206 Forestry Bldg.,
Oregon State University
Corvallis, Oregon

Extension Forester
Agricultural Extension Service
Western Washington Experiment Station
Puyallup, Washington

Extension Forester
Agricultural Extension Service
Washington State University
Pullman, Washington

Local offices of the Soil Conservation Service.

U.S. Forest Service, P.O. Box 3623, Portland 8, Oregon

Northwest Christmas Tree Association (The name and address of the current secretary may be obtained by contacting a farm forester or the U.S. Forest Service at the above address)

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

PACIFIC NORTHWEST REGION—STATE AND PRIVATE FORESTRY

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CULTURAL PRACTICES FOR GROWING CHRISTMAS TREES IN THE PACIFIC NORTHWEST

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FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

CULTURAL PRACTICES FOR GROWING CHRISTMAS TREES IN THE PACIFIC NORTHWEST

INTRODUCTION

s bulletin describes various cultural ctices that are used to produce lity Christmas trees in the Pacific thwest. Many of the described ctices apply to both natural stands plantations. Others apply specifi- ly to one or the other.

it 75% of the trees cut in the ific Northwest in 1966 were cultured. trend is toward more cultured trees n both natural stands and plantations, fewer uncultured trees. This is narily due to increasing consumer and for higher quality trees. It is o caused by a growing scarcity of isfactory wild trees available for istmas tree cutting.

tural practices are not a cure-all unsuitable Christmas tree sites. e sites are too poor to produce vigor- trees with good form and color. er sites are too good. They produce t, excessively open growth with widely ed branches and are better suited for ing timber than Christmas trees. rienced growers do not attempt to t adverse tendencies on unsuitable s. They choose the best type of stmas tree land and apply sufficient ural practices to attain high produc- of quality trees. Like any other ness, Christmas tree growing is ly competitive. Competition can be met by producing a superior uct.

cultural practices covered in this etin are in current use. New hiques are being developed by ers and experimenters. Techniques work for one grower may not be ctive for another who has different ies, rainfall, slope, elevation or type. Some growers on low site s produce marketable unsheared es by thinning and pruning alone. rs, particularly on higher site lands, find it necessary to include additional practices, such as shearing. A great deal of costly trial and error can be eliminated by consulting with a Christmas tree specialist and checking successful local Christmas tree operations.

B. DEVELOPING A NATURAL STAND

Natural stands suitable for Christmas tree culture should contain many thrifty young trees of Christmas tree size or smaller. A few trees may shape up quite well under natural conditions. Most of them will not develop into high quality Christmas trees unless they are cultured. Some are growing too close together for good branch development or are suppressed by competing hardwoods. Others have ample space to grow but are lopsided or spindly. By culturing suitable natural stands, the grower can improve tree quality to produce up to 20 times as many merchantable trees on the area. At the same time he can attain a sustained production year after year by selective removal of all trees before they exceed Christmas tree size.

1. Matching Species to Site

Most unsheared Christmas trees are produced in natural stands on Site IV and Site V lands. These low sites are relatively unproductive for growing timber, but may produce excellent cultured natural Christmas trees. Slow tree growth causes closely spaced branch whorls which give Christmas trees a desirable bushy appearance without shearing. Slow growing trees do not usually lend themselves well to shearing because cut branch tips recover too slowly with new growth. Low site, natural Christmas tree stands are typified by the following:

a. Dry, glaciated soils of the southern Puget Sound area. More Christmas trees, mostly cultured natural

Douglas-fir, are produced here than in all other areas in Oregon and Washington combined.

b. Shallow soils of the high Cascade Mountains, particularly on southerly to westerly exposures. High elevation true fir is most adaptable and should grow 10" to 14" per year.

c. East side forest lands where growth rate of concolor fir or pine is 8" to 12" per year.

Unsheared Douglas-firs are produced on poorer timber growing sites where the distance between whorls does not exceed about 12 inches. Faster growing conditions would require shearing to produce quality trees.

Shearing can be effective in natural stands as well as in plantations. Douglas-fir is the species most frequently sheared, but grand fir, shore pine, and white pine are also adaptable. Best results are on moderately productive Site III cutover lands. Response to shearing is usually undependable on slow-growth areas, Sites IV and V, unless fertilizers are used to stimula growth. On the other hand, shearing extremely rapid growth areas, Sites I and II, requires very severe cutting and may produce heavy, unattractive stubs.

2. <u>Planning the Work</u>

More Christmas tree operations fail through lack of good planning than for any other reason. The key to a success ful operation is the development of a sound "work plan" before the job is started. The plan should be based on a careful analysis of what jobs need be done, how they will be accomplished and the priority of each job. Experienced growers may only need to develop a logical plan of action in their mind Inexperienced growers are advised to write down their work plan and have it reviewed by Christmas tree specialists or successful growers.

They are also advised to get as much background knowledge as possible by reading Christmas tree publications, participating in local farm forestry and Christmas tree associations, and participating in field trips.

Individual work plans will vary, with both site conditions and circumstances of the grower. The following guidelines are applicable to work plans for developing most new areas:

a. Make a list of all jobs that should be done. Include those needed to develop the area and protect the trees, as well as those needed to culture the trees.

b. Decide when each job should be done. Culture as many trees as possib during the dormant season, August to April. Trees cultured during this period will have a head start by being prepared for the growing season. The timing for certain jobs, such as herbicide application, shearing pines, chemical brush control, and slash

ning is closely controlled by the son of the year.

. Give top priority to work that needed to protect trees from serious immediate damage. Examples might be cing to exclude livestock, trapping baiting to control mountain beavers, ning and patrolling to stop seasonal spass, or burning to abate a slash ard.

. Start by culturing a small trial a, say about 1/2 acre, if unsure of tural procedures. This will permit ing various techniques, comparing ls and equipment, and making time cost study estimates. Have the al area examined by a Christmas tree cialist and obtain his suggestions ore culturing on a larger scale.

. Start cultural work where the t production can be accomplished and re the need is the greatest. This usually where the greatest number marketable trees can be cultured in shortest time. However, in some es, it might be older stands where es will grow too large unless they cultured immediately.

. Plan realistically. Most inex- ienced growers overestimate what y can accomplish. Acreage that can cultured each year may be computed n total work days that will be avail- e and average daily accomplishment.

Hardwood Control, Space Thinning, and Basal Pruning

e three practices are the "musts" evelop natural stands for Christmas es. They are often carried out as sngle operation but each requires dvidual techniques. New growth ng the succulent stage is easily nged. Growers should do cultural during the dormant season, start- in late summer when new growth has ened off. The grower can usually a to start marketing the trees two hree years after culturing.

Many growers find that additional cultural practices, which will be described under Section D, "Additional Techniques", may also be profitable, but the following three basic practices should be done first.

a. Hardwood control is necessary to reduce competition for space, moisture, and sunlight. Hardwoods also spread abundant seed and retard reseeding of desirable species. Larger stems are cut with chain saws, power brush cutters, or bow saws. Smaller stems are usually cut with machetes or light axes, which are also good tools for space thinning and basal pruning.

Stump sprouting can be controlled by spraying freshly cut surfaces with chemical brush killers (herbicides) such as 2, 4-D or 2, 4, 5-T. Garden-type compressed air sprayers make satisfactory herbicide applicators. They give good spray control for avoiding accidental damage to Christmas trees. Several treatments may be necessary before roots are killed. Cutting down larger hardwood trees and spraying the stumps is a better practice than girdling and leaving them standing. Branches of dead standing trees interfere with small Christmas trees that are growing through them. Also the dead trees will eventually decay and fall over with risk of damage to Christmas tree growing stock.

Another way to control brush and small hardwood trees is by spraying their leaves with a herbicide, using a pressure-type sprayer. This treatment, called foliar spraying, is most effective in June and July. When Christmas trees and brush are so closely intermingled that foliar sprays might accidently damage the Christmas trees, it is safer to cut the brush and spray the freshly cut stubs.

Control of different species may require different chemicals, concentrations, and techniques of application.

Specifications should be obtained from your farm forester or county agent.

b. Space thinning is accomplished by removal of excess coniferous trees in order to give each future Christmas tree room to grow. Christmas trees need full light from all sides. Crowded trees develop uneven crowns, weak branches, and suppressed foliage. Most growers strive for an average spacing of 5 feet. Closer spacing may be utilized where a lower level of small trees or seedlings is being developed to replace taller pruned trees that will soon be cut. A good spacing guide is to allow enough distance between trees to prevent the branches of each tree from contacting or intertwining with those of its neighbors.

Inexperienced growers are more inclined to thin too lightly than too much. They frequently fail to allow extra space for growth expansion when trees require several more years to develop. Trees suffer in quality when branches are allowed to grow together. Wind action rubs off needles and causes abrasions, shaded needles and twigs become weak and contorted, and the crowns become lopsided.

Initial thinning often removes more trees than the number retained. This gives the grower a good opportunity to select and save the very best ones for Christmas trees. Selection should be based on natural form, density, limb structure, color, and thrift, as well as proper spacing. Certain trees appear to grow faster than their neighbors and develop an open form. These should be removed in favor of compact, bushy trees that have a natural tendency to shape up well for Christmas trees.

Once started, thinning is a continuing job. It should be repeated as often as necessary to maintain adequate spacing of potential Christmas tree growing stock. Most growers thin their stands every year or two and combine thinning with other periodic jobs such as brus cutting and pruning. Periodic thinni removes the following types of unmerchantable trees:

(1) Those growing too close together

(2) Those that have been cultured, but for some reason fail to develop properly.

(3) Those that have grown too large Christmas trees and are not need for seed trees.

(4) Heavy-branched stump cultures th are growing next to seedlings th will develop sooner into Christm trees.

(5) Species that are not in demand.

Harvesting merchantable trees is a fo of thinning. Removing marketable 5- to 7-foot trees, together with some crowded smaller trees that are marketable, creates openings in the stand. However, harvesting alone seldom accom plishes the degree of thinning that is needed. Periodic thinning should remo sufficient additional trees to maintai proper spacing.

Many growers retain one or two older trees per acre for seed production to insure a perpetual crop of new seedlin to replace trees that are cut. Seed trees should be pruned high to prevent shading of the Christmas trees, but no more than 1/3 of their live limbs shou be removed. Seed trees should be left in pairs, where possible, to facilitat cross pollinization of cones. Viable seed production usually starts when th tree is about 30 years old. Selected seed trees should be full crowned, healthy, and with good natural Christm tree form.

c. Basal pruning is the removal of unwanted lower branches between the bottom whorl of the Christmas tree and the ground. Light axes, machetes, and hand pruners are used for this work.

bottom whorl should be carefully ected because it forms the foundation the Christmas tree. It is the first d whorl above the heavy shade of ns, grass, brush, and other ground er. The whorl should consist of four, preferably more, well-formed, evenly ced branches. It should not be ated below serious defects, such as erfect upper whorls or excessively e-spaced whorls called "goosenecks". order to meet these standards, it is etimes necessary to basal prune to eight of 6' or more above the ground. should be kept in mind, however, t taller trees are difficult to ch for shearing. These tall trees uld be removed if they do not begin shape up well within two or three rs.

)nly one or two whorls of branches ire removed in basal pruning this ;oncolor fir in eastern Oregon. Removal of more branches would ;ause excessive shock and growth retardation to this naturally ;low-growing tree.

:rees are naturally slow-growing and n;lete pruning below the basal whorl ld be so severe as to overshock and t the tree, one or more whorls cld be left near the ground to port adequate growth. These may be gradually removed as the tree develops additional height and vigor.

Fast-growing species, such as Douglas-fir, may need pruning when they are 3 or 4 years old. Slow growers, such as some noble firs, may need only the handle and perhaps one whorl just below the handle pruned a few years before cutting. A fuller, better formed basal whorl will develop if the tree is pruned at least two years before it is cut.

Basal pruning accomplishes the following for your trees:

(1) Helps control excessive growth. When an unsheared type tree is desired, basal pruning shocks the tree by removing a portion of the needles, which are its food manufacturing plant. It reduces leader growth for several growing seasons. Studies with Douglas-fir, for example, have shown that removing half of the live crown reduced leader growth of most trees about 25% during the first growing season after pruning and about 30% during the second growing season after pruning.* Thereafter, trees gradually recover from the pruning shock and usually regain a normal growth rate during the fourth growing season after pruning.**

Ideal annual leader growth for unsheared Christmas trees is between 10" and 14". By trial and error, a grower learns to judge the degree of basal pruning that will likely result in this amount of annual growth. His judgment in each case is influenced by past culturing experience with similar trees that grew in the same area.

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*Bernard S. Douglass: Cooperative Study, U. S. Forest Service, Portland, Oregon 1960-1962.

**Joseph Buhaly, Washington State Ext., Serv; Loren Curry, State of Washington Dept., of Natural Resources; and John Hultgren, Soil Conservation Service, Study 1957-1961.

(2) Gives unsheared trees a more bushy appearance. Approximately the same number of needles and buds are produced on a branch regardless of its length. When basal pruning causes a shorter annual branch growth, more needles and buds per foot of branch are produced. This gives the tree a more dense, compact appearance.

(3) Relieves suppression of bottom whorl. The bottom whorl needs open light and adequate growing space to stimulate strong branches, healthy needles, and new buds. Basal pruning accomplishes this in two ways: It develops the bottom whorl above the heavy shade of low brush, ferns, and other ground cover. It also removes competing branches below the bottom whorl that shade and suppress the inside twigs of the bottom whorl.

(4) Forms an adequate handle. Basal pruning should develop a smooth, knot-free handle. The handle is defined as the stem of the Christmas tree just below the bottom whorl. Its length is about 1" to 1½" per foot of Christmas tree height. Branches pruned from the handle should be cut flush with the bark to prevent both stubs and large scars.

(5) Clearly indicates the usable portion of the tree. After basal pruning the handles and crowns stand out clearly to guide future cultural work and harvesting operations.

4. Shearing Natural Stands

Shearing is becoming increasingly important for improving the shape and density of natural stands of Christmas tree size, particularly Douglas-fir on Site III lands. Shearing techniques are described in detail under Section D, "ADDITIONAL CULTURAL TECHNIQUES".

5. Access Roads

A main access road to the Christmas tr area is needed for culturing and harve ing. It should be constructed to all-weather standards to permit winter use Existing public roads passing through the area may serve for main access. Private roads may also serve this purpose if they are constructed with adequate grades, surfacing and drainag They have an advantage in controlling access to reduce trespass.

In addition to the main roads, a syste of parallel secondary access roads should be constructed throughout the cutting area at 200- to 400-foot intervals. These roads make every portion of the area easily accessible to vehicles and workers. Road constru tion destroys trees and removes strips of land from production. Therefore, locations should be designated before the area is cultured.

Another important purpose of roads is fire protection. This is covered unde Section E, "PROTECTING THE TREES".

C. DEVELOPING A PLANTATION

1. Recent Upward Trends

During the past five years, the harves of plantation-grown Christmas trees in Oregon and Washington has increased by a startling 500%. Plantation trees accounted for more than 5% of total production in Washington and 15% of total production in Oregon in 1966. The principal plantation-grown tree is sheared Douglas-fir. The other more important plantation species are shear Scotch pine, sheared shore pine, noble fir, and grand fir. Advantages of plantations over cultured natural area include complete control of species, composition, full utilization of the area, and greater efficiency in culturing and harvesting operations.

Matching Species to Site

st successful Christmas tree planta-ons have been established on cleared nds formerly used for growing agri-ltural crops. Production of highest ality trees is usually obtained where il is well drained, easily tilled, and equately fertile as determined by soil sts. Land that is marginal for produc-g agricultural crops will often oduce excellent Christmas trees. owth characteristics of native conifers owing near the plantation site should ve a clue to future growth rate and rvival that can be expected for planted ees.

st sheared Christmas tree plantations e on Site III lands. Such lands are ted as moderately productive for grow-g timber. From the Christmas tree andpoint, they produce sufficient vigor r adequate growth recovery after shear-g. Yet, they do not produce the exces-ve, difficult-to-control type of growth at is frequently associated with trees Site I and Site II lands. Extremely pid growing conditions are usually tter suited for growing timber than ristmas trees.

antation grown true firs, such as and, concolor, noble and Shasta red ow more slowly than Douglas-fir and st species of pine. These species ually produce highest quality Christmas ees when unsheared and their growth tes are controlled by other cultural eatments.

oper matching of species to site is of the most important decisions for ablishing a successful plantation. s subject is discussed in detail in letin #4 of this series "Selecting Area For Growing Christmas Trees in Pacific Northwest". New growers uld consult a Christmas tree special-s or experienced local grower to ermine which species and strains are t adapted to their particular plant-n sites. Planting two or more species usually a good practice. It spreads the risk of loss from insects or diseases that are partial to a particular species. It also enables the grower to supply a wider market demand.

3. Jobs Preliminary to Planting

At this point it is assumed that the grower has selected a good plantation site and knows what species to grow. He is now ready to start his planting program. The following jobs should be done before planting:

a. Ground should be plowed, disked, and harrowed before planting. Summer fallowing is necessary on old fields or pastures where heavy sod has formed. Newly planted trees cannot survive with competition for moisture and light from a heavy growth of grass and weeds. This problem is greatest on better agricultural soils.

Another reason for eliminating grass and weed cover before planting is to destroy the natural habitat of rodents. Mice and rabbits sometimes wipe out entire plantations by girdling and nipping small trees. Grass and weeds also cause a build-up of root-eating pests such as gophers and June beetle larvae. Plowing and fallowing cause them to starve or move out of the area.

b. Planting stock should be ordered well in advance of planting and arrangements made for delivery or pickup just prior to planting.

Seedlings may be purchased from the Dwight L. Phipps, Forest Nursery, c/o Oregon State Department of Forestry, Salem, Oregon, or the Mike Webster Forest Nursery, c/o State of Washington Department of Natural Resources, Olympia, Washington. They may also be purchased from several private tree nurseries, which specialize in Christmas tree stock. Check with your local forester.

c. Seedlings are packed in waterproof bags or in tight bundles at the nursery for convenient shipment.

Wet shingle tow, moss or other absorbent material is placed around the roots to protect them from drying. Water should always be poured through open-ended bundles as soon as they arrive to replenish moisture lost during shipment. Bundles or bags should be stored in a 35^{o} - 40^{o} F., cooler if one is available. Otherwise, store them outdoors in a cool, protected spot.

Unless outdoor stored trees are planted within about a week after delivery, they should be removed from the bundle and heeled in where there is sufficient moisture, shade, and protection from drying winds. Instructions for this operation are enclosed with the bundle.

d. Some plantation owners have improved growth rate and survival by planting larger sized stock called "transplants". Nurseries that handle transplants sell them for about twice the cost of regular 2-year-old seedlings. Where nursery-grown transplants are unavailable, they can be developed in home transplant beds from regular 2-year-old nursery seedlings.

Instructions for growing transplants follow:

Select a transplant bed with the same care as used in selecting a good garden spot. Plant the seedlings 1" or 2" apart in rows. Space the rows 6" to 10" apart, depending on the type of cultivation equipment that is used. Water the transplant beds regularly during dry periods and control grass and weeds by shallow cultivation, chemicals, or surface mulching with 2" or 3" of sawdust or similar material. (If sawdust becomes mixed with the soil, it causes a loss of nitrogen. A nitrogen fertilizer must then be added to the soil to restore its productivity.) After one or two growing seasons, lift the transplants from the beds and plant them permanently in the field. Growers should consider purchasing or growing transplants when husky planting stock is needed to improve survival and shorten the rotation. Some of the successful growers who specialize in grand, noble, Shasta red, and other true firs have found that better survival of transplan more than justifies the added costs.

4. <u>Planting Techniques</u>

Planting requires special techniques for good survival. The local forester should be consulted. Early spring planting is usually more successful tha fall planting, especially on heavy soil that are subject to frost heaving. Small acreages are usually planted by hand using a planting bar or shovel. One man can plant 500 to 1,000 trees per day. On larger areas, it is frequently more economical to use a tractor-drawn planting machine which can plant 10 times faster than by hand. These machines are available on either a rental or contract planting basis.

Recommended spacing to grow the popular 6- and 7-foot tall trees is about 5'x5' spacing (1740 trees per acre). This spacing permits the maximum number of trees per acre without crowding the crowns or roots. Planting in perfect squares permits cross-cultivating and cross-mowing. This may be accomplished by scoring the ground lightly in two directions before planting to mark out a square grid for a guide, or by planting along a wire marked at 5-foot intervals.

However, many growers who use herbicide to control grass and weeds believe that the added cost of planting in perfect check rows is unjustified.

Loss of planted trees is greatest during the first year after planting. Survival of up to 99% has been experienced under favorable conditions. On the other hand, survival of less than 50% may occur on very severe, soddy, or rodent infested sites. Retaining some trees in a transplant bed will provide a handy source of planting stock to replace dead trees.

ach species should be planted in eparate areas rather than intermingling hem or alternating the rows. Faster rowing species are apt to crowd out he slower species in mixed plantings. ixing species also complicates cultural ork and harvesting operations.

. Weed and Grass Control

hallow cultivation was formerly the sual method for controlling grass and eed competition. It has been largely eplaced by spraying the ground with a hemical weed and grass killer. trazine is the most effective chemical nown at this time for West Coast onditions. It can be safely applied to ither established or newly planted reas.

Chemical spraying to control grass and weeds is usually longer-lasting and less costly than the older method of cultivating between the rows.

st time of application is February or rly March on areas that have been newly anted on clean-cultivated ground. A least 2" or 3" of rainfall is required to insure adequate penetration o the chemical into the ground prior to the growing season. Atrazine is also efective for controlling existing grass and weeds in older plantations. Recommended application is 3 to 5 pounds per acre for newly planted fields and 4 to 6 pounds per acre on established grass and weeds. Reapplication every year or two, as needed, is recommended.

Other methods of weed and grass control have been tried with varying success but usually proved more costly and less effective than Atrazine.

Fern, blackberry, Canadian thistle, and other herbicide resistant plants may become established in two to four years. These should be mowed in early summer. Rotary or reel type mowers that chop the vegetation finely are preferred by most Christmas tree growers. The resulting mulch decays rapidly and most of the fire hazard and rodent habitat is eliminated.

Mowing benefits the plantation by eliminating shade on the lower branches, reducing fire hazard caused by dry standing grass and weeds, and removing the cover for rodents. Some growers dispense with mowing on sites where grass and weed cover is naturally light or can be controlled with chemicals. If a plantation is not mowed, or chemically treated to control grass and weeds, the following precautions should be taken:

a. Firebreaks should be constructed by plowing strips or maintaining a network of roads that are free of grass and weeds.

b. Trees should be basal pruned sufficiently high to prevent severe shading and suppression of the lower branches by grass and weeds.

c. Close observation is necessary to prevent a buildup of rodents, especially meadow mice. Baiting, trapping, or repellents may be necessary.

6. Basal Pruning

Basal pruning of natural stands has already been discussed. The same

principles apply to basal pruning of plantation trees, except that bottom whorls are usually located much closer to the ground. The selected bottom whorl should be located at least 9" to 12" above the ground to permit an adequate handle and, in any event, above crooked handles, or heavy shade caused by unmowed grass and weeds.

Excessive leader growth has lowered the quality of this noble fir. Basal pruning, during the previous year, would have slowed leader growth, and at the same time formed a good handle below the selected bottom whorl.

Basal pruning planted trees too early stunts their growth and reduces their general vigor and ability to withstand drought and competition. Therefore, it is advisable to postpone any pruning except removal of multiple leaders, until the tree has attained sufficient size that pruned limbs will not exceed 25% of the total foliage.

7. Adequate Moisture

Natural moisture conditions west of the Cascades are usually sufficient for established trees. However, newly planted trees may succumb to prolonged summer drought. Grand, noble, concolor, and other true firs are much more susceptible than pines. Douglas-fir i intermediate in drought resistance. Sprinkling, flood irrigation, or water individual trees during dry periods wi save many of them. Drought susceptibl species can also be helped by planting on north and east exposures, applicati of Atrazine for weed and grass control clean cultivating, or mulching.

A well managed stand of true fir is a beautiful sight. Growth rates are controlled by basal pruning, scarring, and root pruning.

D. ADDITIONAL CULTURAL TECHNIQUES

The following cultural practices may b applied to either cultured natural stands or plantations:

1. Shearing

Shearing is cutting back leaders and lateral branches to perfect the cone shape, control the percent taper, and increase the density. Instructions for shearing Douglas-fir, true firs, and pines will be described separately as each requires a different technique.

a. Douglas-fir. Shearing is quired to develop high quality, bushy, ll shaped trees on Site III or better nds. Practically all cleared agricul-ral lands on the west side fall into is category. A good rule of thumb to plan shearing for any Douglas-fir, gardless of site, if it contains inter-dal spacing of more than about 14". e trees may be sheared any time tween the late succulent stage in ly or August until the bud bursting age in early spring. However, late cculent shearing is recommended during e year of harvest. Branch tips cut ring this season lose much of their ubby, fresh-cut appearance before the rvesting season.

emand for plantation-grown sheared ouglas-fir has increased tremend-usly in recent years. However, nsheared, cultured natural ouglas-fir production still leads y a wide margin in the Northwest.

ent shearing experiments have shown t quality of plantation-grown sheared glas-fir may be improved and the ation shortened by progressively rtening the length of sheared leaders a year as the tree approaches chantable size. Good results were ained by leaving leaders up to 20" g on 3' or 4' trees, cutting them a to 16" the next year, and cutting them back to 12" thereafter until the trees were harvested. By contrast, leaders that were pruned back each year to 12" resulted in excessively stubby, dense trees that required at least one additional year to develop 6' or 7' heights.

Pointed out is where the leader on this Douglas-fir was pruned during the previous year. A new leader has formed from a single bud left just below the cut. Tips of the lateral branches were sheared at the same time to improve tree shape and also to keep the top whorl from forming multiple leaders.

Some growers shear the leaders and top whorls with hand pruners as a separate operation from the side shearing. Others shear both the leaders and lateral branches with a shearing knife, hedge shears, or power clippers as a single operation. Basic techniques are the same either way. The leader is cut back at a 45° slant, leaving a single bud about 1/4" below the high point of the cut. Whenever possible, this top bud is selected 1½" or more above a cluster of internodal buds on the leader. Any additional buds within 1½" from the top bud are usually picked off to discourage the formation of multiple leaders. The top bud forms next year's

leader and the internodal buds below it develop into lateral branches.

At the same time the leader is pruned, the tips of the lateral branches of the top whorl should be pruned back to restore good proportion and prevent them from turning up to form multiple leaders. Ideally, the cut should be made just above an internodal bud on the lower side of the branch or two opposite side buds. Leaving a bud on the top side of a sheared branch tip results in an unsightly in-pointing branch.

Finally, the tree is side sheared. Side shearing establishes the taper between the top of the sheared leader and the bottom whorl of the tree. A narrow (50% to 60%) perfectly uniform, cone-shaped taper produces best results. Taper is increased to 60% to 70% during the final shearing before harvest. This widening is accomplished by shearing very lightly and skillfully the last year. Resulting appearance is natural and stub free.

Once started, shearing must be continued each year until the tree is harvested. Trees that are sheared more than two years usually lose their outward appearance of having distinct whorls because growth of internodal branches is stimulated and fills in the internodal spaces. A lighter type of shearing can be accomplished by shearing only one or two years before the tree is harvested. This method narrows the taper, perfects the shape, but does not stimulate growth of internodal branches to such a degree that the internodal spaces between whorls are completely filled in.

b. True firs. True firs do not respond as favorably to shearing as Douglas-fir. This observation holds especially true for noble, Shasta red, and concolor firs, but to a lesser degree for grand fir. Best quality noble, Shasta red, and concolor firs are generally developed by preventing excessive growth by shock treatments--basal pruning, scarring, and root pruning--rather than by shearing. However, excessive leader growth, excessive width, lopsidedness,lost lea buds, or poor density will sometimes o despite efforts to control adequate spacing between the whorls. Such tree can often be restored to at least merchantable quality by timely shearing o the leaders and side branches. Specia techniques for doing this are required for the true firs.

Leaders of true firs are sheared in th same manner as described for Douglas-f to produce growth of about 10" - 14" each year. Whenever possible, the leader should be cut during the late succulent stage when new growth is jus completed. This timing encourages the top bud to become more erect and bette adjusted to produce vertical growth and an adequate number of terminal bud the following year.

Leader shearing of true firs has sever disadvantages. An offset, called a "dogleg" frequently forms on the shear leaders where the top bud turns upward to form a new leader. Also, the newly formed leaders frequently contain only three terminal buds like a branch instead of five or more evenly spaced buds as usually occur on a natural leader.

Fork shearing is recommended for th true firs. Individual branch tips are cut just above a fork of second ary branches.

ide shearing with a knife, hedge hears, or power clippers, as recommended for Douglas-fir, does not produce ood quality noble fir and Shasta red ir. Results are variable for grand ir and concolor fir. A special method, fork shearing", has been developed for he true firs. It consists of removing ips of individual lateral branches ith a hand pruner just above a fork in he branch formed by oppositely rranged secondary branches. Sufficient ranch tip should be removed to attain esired shape and taper. Fork shearing oes not cause noticeable stubs and it evelops symmetrically formed branch ips.

c. Pines. Unsheared pines, as well s sheared pines, produce marketable hristmas trees where leaders do not row more than 12" to 14" per year. xamples of unsheared pines are east ide lodgepole and ponderosa on slow rowing sites. Shearing in such areas sually results in poor bud formation nd a less marketable product than he natural tree.

igh quality trees are produced in he Northwest by shearing either cotch pine, shown above, or native hore pine. However, there is much ess demand for pines than for firs n the West Coast markets.

Most pine plantations, however, produce widely spaced whorls, inadequate density, and excessive tree width unless the trees are sheared. Successful techniques for shearing pines have been developed over a period of many years by growers in the East and Lake States. These same techniques have produced excellent results on many plantations in the Pacific Northwest.

Leaders and lateral branches are sheared back when natural leader growth first exceeds about 12" above an adequately straight handle. This usually occurs the third growing season after planting, or when trees are 2' to 4' in height.

Proper season to shear pines is very critical in order to produce good budding. Shearing should begin in early summer when elongation of the succulent growing tips (candles) is nearly complete and the new needles are about half elongated. In about 6 weeks after shearing, tips of succulently sheared branches will form new bud clusters at the base of needles. The new clusters contain many more buds than unsheared branch tips; thus resulting in a compact, bushy tree with good symmetry.

Scotch pine is a dependable bud producer for about 4 to 6 weeks after the beginning of the shearing season. Shore pine and Austrian pine are less dependable as bud producers unless sheared very early in the shearing season. For this reason, pine growers should schedule their work to give earliest shearing priority to shore pine and Austrian pine.

Shearing is accomplished with either a shearing knife, hedge shears, or power clipper. The leader is cut off at a 45° angle to a sheared length of about 12". Next, the top whorl is sheared to slightly less than half the length of the sheared leader. Finally, the lower branches are sheared to produce a perfect cone-shape with a 50% to 60% taper. Shearing once started must be continued each year.

Some growers shear the leader and top whorl with a hand pruner or knife as a separate operation from the side shearing. Others shear the leaders and side branches at the same time as one operation. In either case, the last shearing operation before the tree is harvested should permit widening the taper to about 60% to 70%. This is accomplished by carefully shearing only the tips of the longer branches to produce a minimum of stubs and a maximum of natural-shaped branch tips which most customers prefer.

2. Disbudding Firs.

Disbudding is the practice of pinching off the terminal, or middle bud, from the bud cluster at the tip of main lateral branches. (The terminal bud on the tip of the leader should never be picked off, since this would cause multiple leaders to form.) Branch growth resulting from disbudding is quite similar to that of fork shearing. It prevents the growth of the main branch tip and allows two or more secondary branch tips to form on each lateral. Disbudding reduces width growth and at the same time allows secondary branches to fill in the internodal spaces. A combination of fork shearing and disbudding is frequently used for the same tree where some branch tips require greater shortening than others.

3. Selective Crown Pruning

Selective crown pruning consists of the removal of individual unwanted branches from the crown of the Christmas tree.

a. Removal of multiple leaders. When the top of a tree produces two or more leaders, all but the best budded should be cut off close to the main stem. Multiple leaders are produced when the terminal bud or leader is broken off or injured. They also develop on some small seedlings.

b. Removal of suckers. Suckers are formed by lateral branches or large sprouts that turn upward along the sid of the stem. They conflict with the horizontal pattern of normal branches and should be cut off close to the stem.

c. Removal of other unwanted branch Any branches that do not conform with the desired shape, symmetry, or densit of the tree should be removed or cut back. Examples are branch tips that are abnormally long or those that turn back toward the main stem of the tree.

4. Scarring of True Firs.

This is a means of slowing growth rat of unsheared true firs by intentional injuring the cambium layer under the bark to cause shock. Trees should never be scarred unless excessive growth threatens to become a problem. The principal purpose of scarring is to reduce the growth rate of trees that have recovered from the retardin effects of basal pruning. It may als be done at the same time as basal pru ing on fast growing unsheared true fi when growth would not be sufficiently retarded by basal pruning alone.

Basal Scarring is the most frequently practiced type of scarring. A strip of bark about 2" to 4" long is skinne off the lower stem with an axe, mache or knife. The scar should be 6" or more below the bottom whorl to avoid disfiguring the handle. Sufficient pruned stem length for scarring, as well as forming a handle, should be considered when basal pruning.

Scarring may be done at the time of basal pruning or at any other time th excessive height-growth becomes a pro lem. The more severe the scarring, t more pronounced will be the next season's growth reduction. Heavy sca ring girdles the stem circumference a maximum of about 75%. Light scarri girdles the stem about 25%.

Root Pruning

ot pruning studies have been made with uglas-fir, grand fir, and noble fir. e method is cutting lateral roots a ovel-depth in a complete circle around e tree about two-thirds of the dis- nce from stem to the drip line. This ually results in drastic shock to the ee, as evidenced by chlorosis (yellow- g of the needles) for one year, and bstantial growth reduction for three ars. This type of shock treatment on and fir caused leader growth reduction 63% the first year and 62% the second ar.*

less severe treatment is cutting the ots on only two sides of the tree. en applied to noble fir, it caused owth reduction of 29% the first year, % the second year, and 25% the third ar; all without causing appreciable scoloration.**

Stump Culture

ump culture is the practice of devel- ing a new Christmas tree from a small nb or sprout left on the stump after Christmas tree has been cut. To make is system work, a cluster or whorl of nches, making up approximately 10% the total foliage of the tree, should left on the stem below the handle. s foliage should be cut back to about f its original length to stimulate tical sprouts, reduce light competi- n to the bottom whorl of the istmas tree, strengthen the branch ucture of the tree, and facilitate ing and other cultural practices. ear or two after the tree is cut, sprouts will form near the top of the stump and produce multiple leaders. The most promising one is left to form a new tree, and competing leaders and remaining branches gradually removed. Some growers have produced three or four successive Christmas trees from a single stump.

*Bernard S. Douglass; Fred Pratt; d James Gibbons: Leader Growth Control udy for Grand Fir Christmas Trees, 50-1961 (unpublished).

**Bernard S. Douglass, U.S.F.S; in Parker; Clayton Wills; and ry Rounsefell: "Leader Growth trol Studies for Noble Fir Christmas es", 1961-1963-1964.

Stump culturing a sprout produces higher quality and quicker results than culturing an upturned branch. Growth of sprouts is encouraged by lopping back the branch tips.

Where stump culturing utilizes an upturned branch instead of a sprout, whorl development will be incomplete for many years. The resulting lop- sided tree will unlikely develop symmet- ric shape as quickly as one developed from a sprout. These observations particularly apply to the true firs.

Since stump cultures usually do not shape up as reliably as natural trees, they are more often grown by necessity than by choice. Few growers bother with stump cultures in cultured natural stands where natural seedlings are plentiful. However, some situations favor stump culturing such as where natural seedlings are scarce, or where planted seedlings are difficult to establish. Other possible advantages

are the creation of mixed-age stands from even-aged plantations or the perpetuation of Christmas tree production from trees having superior genetic characteristics.

7. Fertilizing

Fertilization is a relatively new cultural aid. It is used to improve color, luster, and density of needles and to increase growth rate and vigor of leaders and branches. Slow growing trees with light, off-color needles and weak branches are most likely to benefit. Such trees are most frequently the result of low fertility and summer drought.

Fertilizers must be used with caution. On some sites they may do more harm than good by causing trees to grow too fast or by stimulating rapid growth of competing vegetation. Large scale applications should not be made until sufficient small trials have proven the effectiveness of the application under local conditions. It will pay most growers to have a soil analysis made to determine what types and what quantities of additives are needed for adequate tree response. Instructions for having a soil analysis made may be obtained from your county agent.

Nitrogen fertilizers have proven more beneficial to Christmas trees in most parts of the Pacific Northwest than mixed fertilizers which also contain phosphate, potash, or other nutriments. Urea (46% nitrogen) is a very concentrated form of nitrogen fertilizer. Other nitrogen fertilizers are ammonium nitrate(33% nitrogen)and ammonium sulphate(21% nitrogen).

Best results from nitrogen fertilizer are obtained by scattering it evenly under the drip line in early spring when buds first begin to swell. Nitrogen stimulates needle color, needle bulk, and branch stiffness during the following summer and fall. It stimulates height-growth only slightly during the first growing season after its application, but frequently doubl it during the second growing season. Therefore, except on sites where grow is extremely slow or where shearing i contemplated, nitrogen should normall be applied only to those trees that a planned to be cut the same year. Tri spreads of 1/8 to 1/2 pounds (nitroge weight) per tree are suggested to det mine the least amount that will produ lush, deep green needles.* Particula good results from using nitrogen have been reported on low site glacial til soils of Mason and Kitsap Counties. Good results have also been reported on cultured natural stands of noble f in the high Cascades, Site III and IV cultured natural stands of Douglas-fir and grand fir in western Oregon and some old field plantations where nitrogen level is low.

Although spring is the recommended season to apply nitrogen, substantial color improvement for the next cuttin season can be obtained by applying ammonium nitrate as late as mid-Augus The tree will pick up sufficient nitr after the first fall rains to develop dark green color. Disadvantage of summer application over spring applic tion is lack of needle weight and bra stiffness improvements.

Soil tests may determine that nutrime other than nitrogen, such as potassiu phosphorous, calcium, magnesium, or sulphur may be deficient for Christma tree response. Such deficiencies are

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*Darrell O. Turner, Extension Specialist in outlying testing, and Joseph Buhaly, Extension Forestry Specialist, Washington State Universit "Fertilizing Natural Douglas-fir Christmas Trees", Extension Bulletin 585, May 1966.

** S. P. Gessel, J. W. Duffield, and R. K. Campbell, University of Washington, Seattle, Washington: Results of Christmas Tree Fertilizer Experiment, 1955 (unpublished).

most likely to occur in old fields where continuous past overfarming has dissipated available nutriments. Cost savings can be realized by getting a soil analysis to determine the exact types and quantities of fertilizer that are needed in each case.

E. PROTECTING THE TREES

1. Animals

Livestock should be excluded from Christmas tree growing areas. A good fence provides protection against browsing and trampling by cattle, sheep, goats, and horses. Douglas-fir and grand fir are most susceptible to browsing, particularly during their succulent stage of growth.

Deer are frequently a serious problem, particularly where they become too numerous for available supplies of the more palatable types of forage. Leaders and branch tips deformed by deer can be identified by ragged or stringy breaks where the twigs have been browsed. In certain areas, elk produce a similar type of damage. (Rabbits, mountain beaver, and other rodents clip off the branches with clean cuts made at an angle.) Deer also scrape off bark and break branches by rubbing the trees with their antlers. If deer become a serious problem, the State Game Department may be able to reduce the deer population by extending hunting seasons or issuing special control-hunt permits. High, deer-proof fences are effective, but they are costly to construct and maintain. Several spray-type deer and rodent repellents are available. However, these lose their effectiveness when trees put on a new season's growth and are costly to apply on larger trees.

Rodents are enemy No. 1 to many growers. Meadow mice are particularly troublesome in grassy plantations. They girdle small trees close to the ground. Several weeks or even months may pass before the needles of girdled trees turn brown and the grower becomes aware of the extent of the damage. The most effective control is to destroy the mouse habitat by removing grass and weeds from around the base of the trees. Where habitat control is impractical, water-proof bait stations should be set out at about 40-foot intervals.

Rabbits and mountain beaver cause serious damage in some areas by clipping branches. Three methods are used for control:

a. Baiting.
b. Trapping.
c. Altering the habitat.

Habitat can be altered by clearing or burning log piles, slash accumulations, brush patches, and other protective cover in the area.

Pocket gophers sometimes gnaw and girdle tree roots, causing the tree to die or tip over. This problem most frequently occurs in plantations that are established in old fields. The most effective controls are:

a. Elimination of grass and weeds on which gophers feed.
b. Trapping.
c. Underground baiting.

Information on the identification and control of rodents may be obtained from the farm forester or county extension agent.

2. Insects and Diseases

Light and spotty occurrence of insects and diseases is a normal condition on most Christmas tree operations. This condition should not cause alarm. However, growers should constantly be alert for any signs that an insect or disease is starting to get out of control.

Danger signs are loss of vigor, dropping or discoloration of needles, webs,

spittle, deformed or dying shoots, unusual build-up of insects, and visible fungi fruiting bodies.

Prompt control measures will be necessary to prevent a costly epidemic. The longer you delay, the more costly and difficult control may become.

Frequently, the outward signs of insect and disease damage are quite similar. The first step to take when a build-up occurs is to have the disease or insect identified. Growers should consult with the Farm Forester; County Agent; or Branch of Insect and Disease Control, U. S. Forest Service, P. O. Box 3623, Portland, Oregon 97208. These people can help growers identify the cause of trouble and recommend methods to control the responsible insects or diseases.

a. Insects. Certain insects, such as white grubs and root weevils, attack the roots of trees. Aphids, spider mites, bud worms, tip moths, woolly aphids, scales, needle midges and caterpillars attack the buds and needles. Twig weevils burrow into the pith and kill shoots or small branches.

Usually insects attack only occasional trees and cause a lowering of Christmas tree grade rather than outright culling. However, a sudden increase in the number of insects is a real danger signal. Most insects can be controlled by application of an insecticide. Cost of controlling insects is usually small compared with the value of trees that might be lost during an epidemic.

b. Diseases. The most common disease to Douglas-fir Christmas trees is "needle cast disease" (Rhabdocline). This fungus causes needles to turn brown and drop off prematurely. Individual trees vary in natural resistance. Those that become lightly infected in ordinary years will likely become badly defoliated during years favorable for the spread of the disease. Control measures consist principally of removing noticeably infected trees.

A form of blister rust "Western gall rust" causes cankered swellings on the branches of lodgepole and shore pines. Orange spores develop on some of the swollen areas. The cankers eventually girdle and kill the branch. The best control measure is to cut out infected branches or harvest merchantable infected trees before the branches die. A similar but more deadly disease "white pine blister rust" attacks white and other 5-needle pines. Control with antibiotics is possible, but difficult and costly. Production of 5-needle pines in most areas in the Pacific Northwest may be a poor risk for Christmas tree growers.

The most serious diseases of true firs are the needle rusts. White or yellow pustules form on under sides of the needles during early summer. This is followed by discoloration and shedding of infected needles during the fall and winter. The various rust diseases infect alternate host plants, includin bracken fern and huckleberry. Severit of infection depends on early summer moisture conditions and varies a great deal from year to year. Most effectiv treatment is spraying with Ferbam or sulphur sprays, according to the directions of your farm forester or county agent.

Other diseases are usually of relative minor importance. Root diseases occasionally kill small groups of trees. Certain needle cast and twig blight diseases may cause needles of true fir and pines to die and shed prematurely. These diseases are found most frequent on crowded and suppressed trees. Thinning and removal of badly infected tre will increase the vitality and resistance of remaining trees.

3. Fire

An uncontrolled fire can destroy years of hard work and investment in just a few hours. Adequate fire precautions are one of the best insurance investments that a Christmas tree grower can make.

oth cultured natural areas and plantaions have fire problems. However, the azard is usually greater for natural reas where accumulations of slash, rush, rotten logs, and other flammable ebris are the rule. Grass fires are he main fire problem on plantations. ire prevention and control for both ypes of operations will be considered eparately:

a. Cultured natural areas. The most ffective fire control measure is a netork of access roads through the area. oads provide effective firebreaks to elp confine fires to a small area. hey also permit quick access for fire ighters and fire fighting equipment. n order to remain effective as firereaks, roads should be bladed regularly o keep them free of ferns and other lammable debris.

oads are not completely effective as irebreaks unless snags are felled. parks blown from burning snags cause apid spread of fire. Roads can also e made more effective as firebreaks by urning adjacent heavy slash concentraions during safe periods. Burning ermits from the State Forestry Departent are required during most of the ear.

lturing creates a fire hazard from uned branches, thinnings, and cut hardods. Piling and burning slash concentations on the entire area is desirable. A a minimum, growers should pile and brn in strips along the main firebreaks. Esewhere, they should lop the limbs fom felled trees so the slash will be cose to the ground. This will hasten is decay.

Psting of lands against trespass and cntrolling access over private roads my prevent some man-caused fires. It aso reduces the chance of tree theft.

Gowers can facilitate fire suppression b providing a cache of fire tools in a cntral location. Water holes and ponds my also be developed for an emergency wter supply.

If a fire does occur, it should be reported immediately to the State District Forester or District Administrator. In farm areas not covered by State fire protection, the Rural Fire District Headquarters should be notified.

b. Plantations. Dry grass and weeds are the greatest fire threat to plantations during late summer and fall. Prolonged dry periods during winter and early spring also cause flammable conditions.

The best precaution is the elimination of grass and weeds by cultivating, mowing, or by application of chemical grass and weed killers. Where this cannot be done, firebreaks should be plowed or disked to expose mineral soil. They should be constructed along unprotected portions of the perimeter of the plantation, along public roads where man-caused fires are most apt to occur, and through the plantation to divide it into smaller units for easier control of fires. Grass and weed fires spread rapidly and require fast action to control them. Plows or disks, if readily available, can be used to construct a line around fires. Small fires can often be controlled by beating them out with wet burlap sacks, flat shovels, or even a flail made from a heavy evergreen branch.

4. Trespass

Tree theft is a seasonal problem which occurs during one or two months before every Christmas. This problem is less troublesome when the Christmas trees are growing on your home property and can be watched. The best solution for absentee owners is to establish the operation on a private road with controlled access. Where this is not possible, signs, fences, and locked gates are inexpensive and usually effective precautions. Growers should also obtain the cooperation of neighbors and local law enforcement

officials who can help watch for trespassers. More costly precautions such as a hired watchman or special fencing may be necessary in problem areas. The theft of trees is gradually becoming less frequent because of a growing public awareness of private property status of Christmas trees and penalties for violation of State and County trespass laws. The press, radio, and television, as well as public and private forestry organizations, are doing a good job of informing the people about the laws and regulations. Law enforcement agencies are also cooperating by checking and investigating violations.

F. IMPROVED TREE STRAINS

Geneticists and nurserymen are seeking better Christmas tree strains for tomorrow's growers. Just as ornamental shrubs with special desired characteristics were developed from the original wild plants, superior Christmas trees will eventually be developed from selected natural trees. Two major aims of the genetic improvement of Christmas trees are greater beauty and "self-shaping" to eliminate a great deal of costly cultural work. Needless to say, tree strains that produce good timber do not necessarily produce the best Christmas trees. Improvement of Northwest species for better Christmas trees is still in its infancy.

Scotch pine has received more attention than native species. This species grows naturally over most of Europe, and western Asia. Its great geographical variation in needle color and length, growth rate, branching habit and other inherited characteristics have been intensively studied. The Spanish Guadarrama and French Auvergne strains with short, stiff, blue-green needles are in greatest demand. Reliable Christmas tree nurserymen indicate the strains or characteristics of their planting stock. Some nurserymen collect their own seed from desirable parent trees to insure a reliable seed source.

Provenance tests are being made in the Pacific Northwest to determine the best geographical seed origins of Douglas-fir, grand fir, noble fir, and shore pine for Christmas tree production. Results of these studies, although several years away, will eventually enable Christmas tree growers to select best possible seed sources for their particular area.

Occasional individual Douglas-fir, noble fir, grand fir, concolor fir, shore pine, and other native Christmas trees are found with near-perfect symmetry, density, growth rate, and color characteristics. Such desired trees may be propogated vegetatively in several ways:

1. Stump culture.

2. Grafting cuttings on rootstocks of ordinary trees of the same species.

3. Rooting of cuttings.

All of these practices preserve the characteristics without change. Growers who find these quality trees are requested to report them to their farm forester for future production and breeding work.

Some interest has also been shown concerning the development of seed orchards in which cuttings from desirable parent trees are grafted for cross-pollination and seed production. However, seed orchards are costly to establish and the resulting seeds require thorough testing to assure that the grafts breed true to type. While perhaps many years away, this method of seed production may eventually offer opportunities for improved planting stock.

. SOURCES OF ASSISTANCE AND INFORMATION

ervices of a farm forester are available
o most woodland areas in Oregon and
ashington. The office address of the
ocal farm forester can be obtained by
nquiring at any State Forestry Depart-
ent Office in Oregon or State Depart-
ent of Natural Resources Office in
ashington.

eference material is available from
he County Extension Agent. He can also
dvise growers concerning the avail-
bility of assistance from farm forest-
rs, extension foresters and others who
ork with Christmas tree growers.

dditional sources of Christmas tree
ulturing information are:

xtension Forestry Specialist
ooperative Extension Service
5 Forestry Building
egon State University
rvallis, Oregon 97331

xtension Forestry Specialist
ooperative Extension Service
shington State University
hnson Hall 317-A
llman, Washington 99163

xtension Forestry Specialist
ooperative Extension Service
stern Washington Research and
xtension Center
yallup, Washington 98371

cal offices of the Soil
onservation Service

pecial Products Forester
ivision of State and Private Forestry
. S. Forest Service
. O. Box 3623
rtland, Oregon 97208

rthwest Christmas Tree Association.
he name and address of the current
cretary may be obtained by contacting
n of the above sources.)

NATIONAL FOREST SYSTEM
COOPERATIVE FORESTRY
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
FORESTRY RESEARCH

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

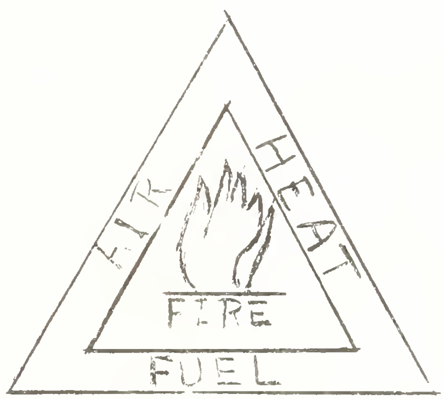
PACIFIC NORTHWEST REGION-STATE AND PRIVATE FORESTRY

PORTLAND, OREGON

No. 6 August 1960

WOODLAND PROTECTION---FIRE PREVENTION

Fire can destroy or damage your woodlands in a few hours and eliminate values that have taken years to develop. A little advance planning or work may prevent such a fire or limit the damage to a very small area.



It takes three things to make a fire burn---FUEL, AIR and HEAT.

Fuel and air are always present in a woodland area. If enough heat is supplied to ignite the fuel, a fire can be started. Fire prevention is usually aimed at elimination of the source of heat. However, this is not always the method. Sometimes the more flammable fuels can be removed or kept away from the source of heat. In this way, a fire is prevented by removal of the fuel. Heat in sufficient quantity to ignite fuel is sometimes caused by lightning, but is much more frequently a result of man's carelessness with equipment, fires or smoking.

Two general approaches to prevention of forest fires are: (1) education of people to make them more fire conscious and (2) closure of hazardous areas to entry and use during periods of high fire danger. The KEEP GREEN program is one of the more effective educational methods. The fire prevention messages are

presented by radio, television, newspapers, posters and talks at schools and other groups. Closure of hazardous areas during the fire season, and shut down of all woods operations during periods of extreme fire danger, prevents fires from starting where control might be very difficult. However, each woodland owner can assist in the prevention of fires on his own lands.

Following are some of the more common causes of forest fires and some ways that you can reduce the chance of fire in your woodland.

Fire Causes and Prevention Methods

(1) Debris Burning Use of fire to dispose of refuse, grass, paper and other debris is a common practice. Burning should be done at a safe spot in a cleared or fire-proofed area. Before starting such a fire, check with your local fire protection agency. During the closed fire season, in areas where a permit is required, a warden will inspect the burning site, specify any needed safety precautions, and will then issue a permit. Do not leave the fire unattended and be sure the fire is completely extinguished before leaving.

(2) Slash Disposal Elimination of logging debris by burning is usually a good practice. By burning this material in the fall or winter, the area can be fire-proofed so there is little burnable material remaining in which a fire can start when conditions are more hazardous. This will also permit the landowner to obtain a slash hazard release so he will not be liable for fire suppression costs of future fires on the area. Disposal of accumulations of debris, slash or other flammable material will lessen the danger of fires being set by incendiarists or children.

Slash burning requires advance preparation to keep the fire from spreading to adjacent lands. In clear-cut areas, this would include construction of a fireline around the area to be burned and falling of snags.

In partial-cut areas, excess accumulations should be piled in larger openings for burning. A burning permit must be obtained during the fire season but this does not relieve the permittee from the responsibility of controlling the burning. He must provide the manpower and equipment necessary to keep the fire from spreading to adjacent areas.

(3) Equipment Operation This includes fires caused by the operation of power saws, tractors, trucks and other power-driven equipment. Sparks from the exhaust system will start fires if they fall on dry materials. Adequate mufflers or spark arresters will break up these hot pieces of carbon so there is not sufficient heat to ignite the fuels. Fires are sometimes started by the power saw exhaust igniting adjacent fuels. Spilling gasoline on the hot muffler or starting the saw at a spot where gasoline was spilled may also cause a fire. These fires can be prevented by using care when filling or operating the saw. Keep a fire extinguisher and shovel with the saw, as required by State law, to control the spread of any fires that may start.

(4) Smokers Burning tobacco or matches may start a fire wherever smokers use an area. Care in extinguishing such material would prevent these fires. In areas heavily used by people, it may be desirable to prepare a fireline around the use area to limit the spread of a fire. This may not prevent a fire but it will confine it and make the suppression much easier.

(5) Campers or Picnickers Fires caused by recreationists are usually not a serious problem except where flammable areas are selected for camping and picnicking. One solution is to limit the use of such areas by campers and picnickers. Most people respect "no smoking", "no campfire" and "fire closure" signs posted in hazardous areas. If there are sites in your woodland community used by campers or picnickers, development of safe spots for the campfires will prevent the spread of such fires.

(6) Lightning Lightning fires are usually started in snags or rotten trees. Falling or harvesting the snags and defective trees will prevent most lightning strikes from starting fires. If a fire is started, it will be on the ground where control is easier.

Other Fire Prevention Practices

Posting a woodland area with "no trespassing" signs may prevent some fires by keeping people out of your woodlands. However, this is difficult to enforce and may antagonize some people causing them to set fires in the area. Also, authorized users of the area can still cause fires.

One of the most effective fire prevention factors on a woodland area is a complete stocking of trees. A well-stocked stand of trees, 10 feet or more in height, will reduce the probability of accidental fires. The tree tops prevent most of the sun's rays from reaching the ground to dry the surface fuels. This means that more heat is needed to start a fire. The stand of trees also limits the ground speed of drying winds. Lack of sunlight will eliminate or lessen the growth of many plants, such as grass and fern, which create a fire hazard in open areas. A fully stocked woodland will have fewer fires and fires will be easier to control than on cut-over or poorly stocked forest lands.

Fire laws and regulations have been enacted to prevent forest fires by restricting use or making certain acts illegal. These laws were designed to protect your woodland and all other forests in the State. Every woodland owner and user should comply with the requirements. The cooperation of all owners, users and fire protection agencies is necessary to PREVENT FOREST FIRES.

---FOREST LAND WORTH HAVING
IS WORTH PROTECTING---

MANAGING YOUR WOODLAND

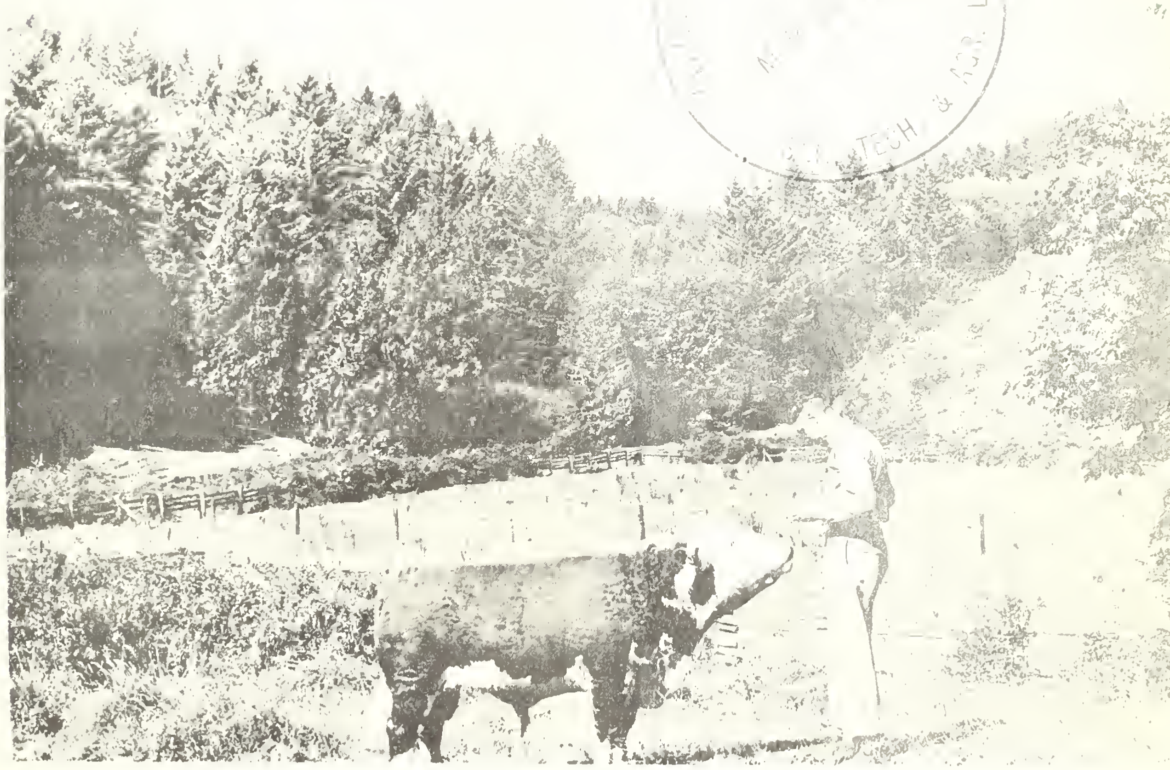
HOW TO DO IT GUIDES

PACIFIC NORTHWEST REGION—STATE AND PRIVATE FORESTRY

PORTLAND, OREGON

No. 7 August 1960

WOODLAND PROTECTION----GRAZING



In the Douglas-fir Region Healthy Trees and Livestock
Are Best Produced on Separate Areas.

The woodland beyond the fence was once a stump pasture.
When stock were excluded the area grew a good stand of trees.

FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

WOODLAND PROTECTION---GRAZING DAMAGE

The production of forest crops can seldom be combined economically with the production of livestock in areas west of the Cascade Range. This is particularly true of hardwood stands and relatively shallow-rooted conifers such as fir, hemlock, spruce and cedar. Trees east of the Cascades, such as ponderosa pine, lodgepole pine and larch are normally deep-rooted and are not seriously affected by grazing use except in the seedling stage. These trees grow with wider spacing and numerous natural openings. This condition encourages the growth of grass and palatable browse and lessens the chance that hungry livestock will damage the trees.

Damage to trees by livestock is caused by:

1. Chewing off new growth of leaders and side branches.

2. Scraping off the bark by rubbing against young trees.

3. Physical damage to shallow roots by trampling.

4. Breaking and killing seedlings by trampling.

5. Compaction of the soil resulting in reduction of its water holding and absorption qualities and reducing necessary aeration of the soil. This will cause reduced tree growth and it can cause the trees to die.

In Douglas-fir and associated species, the loss from grazing damage to a timber stand is usually far greater than the value of the feed obtained from the area, because there is very little forage in a well-stocked stand of forest trees.

Continued overgrazing will periodically kill off some of the trees and eventually cause the stand to become understocked. The surviving trees will be too widely spaced to utilize the area to full advantage. Unless pruned, they will retain their limbs and at harvest will yield fast-tapering, knotty logs of low value. Such a woodland will produce less timber volume and value for the owner than it should. It also will have produced very little forage value.

When a stand of timber is cut, the clearing is exposed to the sunlight so that a variety of plants commence to grow. Seeds from trees, brush, weeds and grasses germinate and start competing for growing space. If the first growing season happens to occur after a good tree seed year (about one year in five) the area may become well-stocked with trees. However, after poor seed years, grasses, weeds and shrubs get a head start and make it more difficult for tree seedlings to become established.

These forage plants attract deer and domestic stock to the area. If this grazing use becomes too heavy, the animals will nip the new growth and buds of coniferous trees causing slow growth, deformed trees and some mortality. Many young trees will also be killed by trampling of cattle and other stock, particularly during wet weather. The unpalatable brush, which is not damaged by the livestock, will continue to grow and eventually shade out most of the grass and young trees that may have started. Such vegetation often prevents new seeds from germinating. The area will then have little value either for grazing or for growing timber.

It is important to protect young trees from grazing damage until their terminal buds have grown too high for animals to reach. A forest plantation is especially in need of protection from grazing. Seedlings from a forest nursery seem to contain nutrients that attract browsing animals. Planted seedlings often suffer serious terminal bud damage from animals while adjacent natural seedlings are undamaged.

Grazing damage on open range areas can best be controlled by fencing domestic livestock out of the forest areas. In areas having a herd law, confining your own stock to pasture areas by fencing would accomplish the same objective. If trees are needed for shade or shelter, fencing should permit access only to the particular portion of the woodland set aside for that purpose.

Grazing damage by deer is usually not as severe as by domestic animals but is much more difficult to control. Fencing is expensive. Increased harvesting of deer by hunters should be encouraged instead of closing the area to hunting. In many areas, an either-sex deer season or a special late season is effective in bringing game population and available forage into a favorable balance. Where there are sufficient other kinds of palatable browse, deer damage to conifers is usually not a serious problem.

A forest landowner should compare the long range income from forest crops on his land to the short term value of the land for grazing. If grazing is more important to him than forestry, the area should be developed exclusively for grazing. It should be cleared, seeded to grasses or other forage, and managed for maximum livestock production. If the landowner decides that the greatest benefit to him would be timber production, grazing should be excluded and every effort made to obtain maximum timber production.

To realize the greatest return from his forest, the owner should keep it fully stocked with healthy, well-formed trees of species that are in good market demand. This objective can be aided by excluding domestic livestock from woodlands and cooperating with State Game Departments in their efforts to control excessive game populations through special hunting seasons and regulations.

---DUAL USE OF WESTSIDE FOREST LANDS FOR TIMBER AND GRAZING USUALLY RESULTS IN LOW VALUE FOREST AND UNDERFED LIVESTOCK---

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

PACIFIC NORTHWEST REGION-STATE AND PRIVATE FORESTRY

. 7 PORTLAND, OREGON Revised January 1969

WOODLAND GRAZING MANAGEMENT

CONTENTS Page

pared by Division of State and Private Forestry, U.S.F.S. with guidance and sistance of: Division of Range Management, U.S.F.S., Oregon State Department Forestry, Washington Department of Natural Resources, Soil Conservation vice, U.S.D.A., and Oregon, Washington and Idaho Extension Services.

FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

A. INTRODUCTION

Forest land should be managed in such a way that the greatest possible benefit is returned to the owner. This benefit is usually measured in terms of dollars. However, there may be other values and benefits, such as esthetics or watershed protection, to consider. Many forest areas are subject to several different kinds of use in order that the owner may realize the greatest benefits. Grazing is often one of the major kinds of use.

The forest-land owner who wishes to use his woodland for grazing should consider the following:

1. What are his short-term and long-term needs?

2. What conditions exist in the woodland?

3. What management practices are necessary?

4. What control of livestock and wildlife is necessary?

B. FOREST TYPES

In the Pacific Northwest, there are two major forest regions. They are separated by the summit of the Cascade Mountains.

On the west side of the Cascades, the principal forest types are characterized by Douglas-fir, true firs, hemlock, cedar, and spruce. Major hardwood species include cottonwood, alder, oak, and maple. On the east side of the Cascades, species such as ponderosa pine, lodgepole pine, Douglas-fir and larch are the most common. Associated with these species at higher elevations are grand fir and hemlock. These two regions must be considered separately when grazing use is discussed.

C. CONSIDERATIONS FOR GRAZING

When a landowner wishes to use his forest for grazing, he should evaluate the quantity and quality of the forage because animal gains are tied directly to both. Quantity is influenced large by the density of trees. Quality is determined mostly by the kinds of plan growing on the area. On the west side recent cutovers and young forests will often have abundant plant growth. However, many of the plants may not be palatable to livestock. Examples are poison oak, salal, gooseberry, and man forbs. Some may even be poisonous suc as bracken fern. In setting up a graz ing program, careful evaluation must b made of the amount of usable forage that is available for livestock and th management practices which must be applied to prevent intolerable damage to young trees and other values.

Older, well stocked stands on the west side usually have a nearly closed crov canopy which greatly reduces the amour of forage produced. In addition, most of the plants palatable to livestock grow poorly in this shade. As a resul these older stands are often almost a "desert" for domestic animals.

On the east side, different timber typ and conditions exist. One characteris type is the open grown, uneven aged ponderosa pine with a ground cover of grasses and palatable shrubs. The lar owner can easily manage this forest fo both timber and forage production. Other east side types are suitable for grazing in varying degrees. Very dens lodgepole pine will have little forage value. However, when dense stands are thinned, conditions for grazing are greatly improved.

A typical dense stand of ponderosa pine. There is very little forage value here.
(Soil Conservation Service photo)

. EFFECTS OF GRAZING

razing in the forest can benefit trees nder certain conditions. In areas here competition for moisture between rees and grass, brush and forbs is ritical, grazing can reduce this ompetition.

study[1] on west side conditions onducted by Oregon State University ndicated that at the end of ten years, eedlings in the controlled grazing lots averaged over two feet taller than hose in ungrazed plots. However, it as pointed out that too early and too eavy grazing use resulted in excessive rowsing of Douglas-fir. Controls used n this study were that sheep would be razed during the spring growing season nd herbage removal would be limited to bout 50% of the available forage. nimals were weighed frequently and emoved when they failed to maintain eight gains. This study further illustrates that sheep grazing, when carefully and properly managed, is compatible nd may assist the establishment of ouglas-fir. After six years this area was no longer suitable for grazing because tree growth shaded out the palatable plants.

One of the major problems of livestock grazing is adequate control of the grazing animals. Too early or too late grazing influences the animal's preference for certain plants. In some situations, tree reproduction becomes quite palatable to the animals resulting in extensive browsing and often serious damage to the trees. When too many animals graze in the forest, they may damage shallow rooted trees or destroy seedlings by trampling. At times, they may scrape off young, tender bark by rubbing.

Distribution of livestock is also important. Whenever animals congregate or heavily use an area, their trampling may seriously compact the soil. This results in reduced water absorption and water holding capacity. Aeration is also restricted.

Severely compacted soil results in slower tree growth and can even cause death of trees. Slow tree growth lowers the potential volume and value of the timber stand.

When there is an excessive loss of trees, the timber stand will be understocked. This also causes reduction in volume and value.

E. GRAZING MANAGEMENT

Foresters recognize that forage can often be utilized without adverse effects on trees because conifers, as forage, are generally less palatable than grasses, forbs,and many species of brush. Domestic livestock will avoid conifers as long as more palatable vegetation is available. However, some physical damage might be caused to trees, depending largely on the numbers or concentrations of animals. Trees less than 3 feet tall are much more subject to browsing and damage than the larger trees.

[1] Reported in Journal of Forestry lume 64, No. 11.

Newly seeded or planted areas should not be grazed especially where some type of site preparation has reduced or eliminated forage plants.

A research study[2/] in eastern Washington has shown that thinning of dense ponderosa pine stands increased forage production on understory plants. Thinning also promoted greater diameter growth and greater wood production on usable trees. Thinning intensities were as follows:

No. of trees per ac.	Spacing (feet)	Avg. d.b.h. at time of thinning	5 yrs. later
250	13.2	4.4	5.4
125	18.7	5.0	6.3
62	26.4	5.8	7.4

Before thinning there were 2,356 trees per acre with spacing of 4.3 feet.

Examination of forage production 3 years after thinning showed that forbs produced more when the pine canopy exceeded 45% and grasses produced more when the canopy was less than 45%. In this period grass production increased from 20 pounds (air dry) per acre in the unthinned to over 120 pounds (air dry) at the widest spacing. Future forage production should increase at a greater rate as the forage plants obtain complete response.

Positive spacing guidelines for thinning to increase forage production have not yet been developed. However, the following guidelines will give good results. If the average d.b.h. before thinning is less than 5 inches, thin to 250 trees per acre at 13-foot spacing. Over 5 inches, thin to 140 trees per acre at 18-foot spacing. More intensive thinning might depend on possible markets for the cut trees.

[2/] Reported in Journal of Range Management, Volume No. 18.

Several east side woodland owners hav been thinning their sapling and pole sized pine stands to improve both tre growth and range conditions. Heavy thinning and seeding with suitable grasses is feasible.

Small bulldozers have been used succe fully for thinning small pine stands. This requires a skilled and careful operator. Strips are cleared with th tractor and then excessive trees rema ing between cleared strips are cut wi a chain saw. Thinning for grazing al requires some slash disposal so that the area is accessible to cattle.

Bulldozer thinning in a 60-year-old ponderosa pine stand.
(Soil Conservation Service photo)

*fter thinning to 16- to 20-foot spac-
ng, this area was seeded with grass
nd alfalfa.
(Soil Conservation Service photo)*

older forest stands, such as the
ked coniferous type on the east side,
gging can also benefit both forage
oduction and the remaining forest.
e mixed coniferous type consists
stly of grand fir, Douglas-fir, larch
l ponderosa pine. The grand fir is
oject to severe heart rot and is not
e most desirable species to keep.
e large study[3/] has shown that removal
f all the larger grand fir (over 16"
.h.), 2/3 of the Douglas-fir and
ch over 16" d.b.h. and 1/2 of the
nderosa pine would increase forage
oduction and encourage reproduction of
e more desirable tree species. The
gging also removed smaller, diseased,
ormed and insect infested trees.

fer this logging, areas of heavy soil
iturbance had to be seeded. In addi-
in to controlling erosion, this
vided an opportunity to introduce
roved grass species. Continued
tdy indicates that timothy is a desir-
be introduced grass and blue wild rye
esirable native species to use in the
ied coniferous type. Orchard grass
and smooth brome are aggressive perennial grasses which have been recommended for many areas. However, these are considered more competitive with trees in the mixed coniferous type than are short-lived grasses such as the timothy.

The study also shows that control of logging methods and slash treatment are necessary to realize the most utilization of increased forage. For example, skid trails should be free of debris, cull trees felled up and down hill and bucked in short lengths and concentrations of slash reduced by burning.

Control or removal of undesirable vegetation is another management practice. It is important to know which plants are most suitable for both domestic livestock and big game. A wide range of herbicides and methods of application are available so that the landowner can generally control unwanted vegetation quite economically.

Obtaining the best utilization of forage also requires manipulation of livestock. This can be done by water development, salting, fencing, riding and selecting the proper age class and kind of livestock. The importance or need for manipulation varies with forest types. For example, in the mixed coniferous type poor forage utilization is common. During a recent study[4/] in this type it was observed that younger animals, such as replacement heifers and yearling steers, were more effective grazers than cows and calves. Using younger animals at the right time, coupled with water development, selective logging, slash disposal and fencing resulted in a threefold increase in animal unit months over a five-year period.

[3/] Reported in Technical Bulletin
o 103, Oregon State University,
ovallis, Oregon.

[4/] Technical Bulletin 103, Oregon State University, Corvallis, Oregon.

A water hole developed in the mixed coniferous forest type. One method of managing cattle for better forage utilization (Soil Conservation Service photo)

Any grazing plans in forests of the Pacific Northwest should also take wildlife use into consideration. The number of deer and elk using an area will have a great influence on the amount of forage available for livestock. Deer especially are present in every forest area in the Region and a certain amount of wildlife browsing will occur.

Rodents are often overlooked, but always present. Depending upon the area, there might be mice, rabbits, gophers, or mountain beaver. Rodents can consume large amounts of forage and also damage or destroy many trees. Too often, inexperienced observers blame rodent damage on deer or livestock.

These simple guidelines developed by the Soil Conservation Service will assist the landowner in establishing and determining proper woodland grazing. An inexperienced landowner will need assistance from a forester or range technician for some of these steps.

1. Develop an inventory with a map showing forage conditions and classes of vegetation.

2. Recognize key forage plants . understand how to determine safe degr of use.

3. Start grazing in spring afte soil is firm, key grasses have grown 4 to 6 inches and key browse is at le 3/4 leafed out.

4. A safe rule is to take 1/2 a leave 1/2 of current year's growth.

5. Decrease utilization on stee slopes and more unstable soils. Slope over 70% generally should not be graze Also, limit grazing on areas having ve loose coarse soils.

6. Recognize game animal damage and how it can influence livestock numbers.

7. No more than occasional trees should show grazing effects.

8. Only a very limited area adjacent to water and along trailways should be permitted to be overused. The remaining areas should be used lightly and within proper use limits t qualify as proper woodland grazing.

F. CONTROL METHODS

The most effective way of controlling domestic livestock is by fencing. Forest-land owners may find it necessa to build fences to keep livestock out of areas of young reproduction where grazing would be harmful. Many times this control is needed for only a few years after planting.

Wildlife control, however, is another problem. Fences suitable for domestic stock will not restrict movements of deer or elk. A certain amount of wild life browsing will always occur. Seve damage generally happens only when excessive wildlife populations develop The use of either sex hunting seasons authorized by State Game Departments then becomes a most effective method of controlling big game population.

his is a recognized technique practiced n most states with large deer popula-ions. Rodents and other pests are ontrolled by trapping and poisoning. efore starting any poisoning campaign, ssistance should be obtained from a . S. Fish and Wildlife Service echnician.

. SOURCES OF ASSISTANCE

everal sources of assistance are avail-ole to the woodland owner interested ı following improved management actices.

chnical advice concerned with general odland management may be obtained om the local farm forester or other restry advisor in your area. For his me and address, contact the county ent or write to:

State Forester
P. O. Box 2289
Salem, Oregon 97310

Supervisor,
Department of Natural Resources
P. O. Box 168
Olympia, Washington 98501

or

Regional Forester
P. O. Box 3623
Portland, Oregon 97208

chnical advice regarding grazing or her related topics is available from ither your county agent or local fice of the Soil Conservation Service.

iancial assistance for carrying on etain improved management practices iht also be available in your county. r local forestry or range advisor or h County Agricultural & Conservation evice office will have this infor-aion.

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GPO 995-451

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

PACIFIC NORTHWEST REGION—STATE AND PRIVATE FORESTRY

No. 8 PORTLAND, OREGON July 1961

CHRISTMAS TREE HARVESTING AND MARKETING FOR PACIFIC NORTHWEST GROWERS

CONTENTS

A. INTRODUCTION

Harvesting and marketing are of vital concern to the Christmas tree grower. For 7 to 12 years he has invested a considerable amount of money and many hours of hard work, culturing his trees into masterpieces of beauty. Yet the success or failure of his entire venture is determined by sales returns during a period of a few weeks. It is not surprising that successful marketing requires the same degree of skill, effort and advance planning by the grower as is needed to culture a field of scraggly seedlings into high quality Christmas trees.

Christmas trees are unique as a commodity. For 11 months of the year they have little or no retail value. Then they suddenly become a valuable item of trade as some 40 million American buyers eagerly seek the tree of their choice. Just as suddenly the Christmas season passes and cut trees become a liability, for it costs money to haul debris away.

The grower must take quick but well planned action to get the best returns

Prepared by: Bernard S. Douglass, Div. of State & Private Forestry, U.S. Forest Service, with the guidance and assistance of:

Oregon State Board of Forestry
State of Wash. Dept. Nat. Res.
Oregon State Extension Service
Wash. State Extension Service
U.S. Soil Conservation Service
Forest School faculties of O.S.U., U. of W., and W.S.U.
Member Growers of N.W. Christmas Tree Assoc.

from his investment. The purpose of this bulletin is to guide him through the brief, but critically important. harvesting and marketing period.

B. QUALITY IS A "MUST"

No amount of skilled merchandising will enable a seller to get top prices unless his trees are of top quality. Many retail lots are overstocked with spindly, sparsely branched saplings that should have been left in the forest. Unsold trees on Christmas day are usually of this quality. Growers, wholesalers and retailers who fail to set their sights on high quality will drop by the wayside as competition for markets becomes keener. In the long run it is the customer who sets the standards for quality. Most customers will not purchase poor quality trees when better trees are available.

C. GROWING THE RIGHT SPECIES

Each year, wholesalers and retailers must decide which species are available and likely to be profitable to handle. Their judgment will affect their returns for only that particular year. The grower, however, must make a longer range decision. The species he plants today will not be ready to harvest for 7 or more years. Market demand for a certain species could change considerably in that time. In order to make a wise selection of species to plant or culture, the grower should consider two important questions:

1. Which species will grow well on his land?

2. Which species will be in good demand at harvest time?

THIS POOR QUALITY TREE WILL BE DIFFICULT TO SELL AT ANY PRICE.

GROWERS SHOULD CONCENTRATE ON HIGH-QUALITY TREES SUCH AS THIS DOUGLAS-FIR.

Advice from foresters or personal experience will help to answer the first question. The second question requires some careful analyzing of past and present trends. In general, the demand for the old stand-bys, Douglas-fir, concolor fir, grand fir, and noble fir is likely to remain firm for many years. Demand for lodgepole pine, shore pine, Scotch pine and silver fir has been increasing during the past few years. These trees now appear to be good risks but only time will tell how long their popularity will continue to increase.

Other species, such as spruce, redwood, cedar and ponderosa pine, have never accounted for a very sizeable portion of our total production. Certain characteristics of these species and long established buying habits of customers make it appear doubtful that the demand will increase in the near future. Growers are advised not to go "all out" for any of the species in low demand. If grown at all, they should be tried on a small scale to supplement a main crop of one or more of the popular species.

D. A LOOK INTO THE FUTURE

Is there a danger of overproduction? Growers in the East are already facing this problem. However, where overproduction has become a problem, growers of high quality trees have found markets at satisfactory prices while low quality trees were unsaleable. Quality is the key to future markets.

What about competition from artificial trees? Trees manufactured from metals, plastics, and other materials are now on the market in direct competition to natural trees. Customers who have had low quality trees, or have difficulty in purchasing a fresh tree, may look to artificial ones as a substitute. Although artificial trees have captured only a small percentage of today's market, their increasing popularity has caused concern to many growers. This presents a real challenge for Christmas tree growers to improve quality and promote the fine qualities of natural evergreen Christmas trees.

What about competition in existing markets from other producing areas?

Christmas tree production in the Pacific Northwest in 1959

Species	Oregon No. of trees	Washington No. of trees	Pacific N.W. No. of trees	%
Douglas-fir	549,000	2,490,000	3,039,000	85%
Concolor & grand fir	277,000	59,000	36,000	10%
Noble, silver & Shasta red firs	55,000	15,000	70,000	2%
Lodgepole & shore pines	45,000	21,000	66,000	2%
Spruces, ponderosa pine, white pine & other species	11,000	22,000	33,000	1%
Totals	937,000	2,607,000	3,544,000	100%

Today about 30% of our production is used in Oregon and Washington and 70% is shipped to other states. More than 90% of our out-of-state shipments go to California. The Pacific Northwest's main competitors are Canada and Montana. Both areas produce good quality Douglas-fir almost all of which are uncultured, natural trees. However, Pacific Northwest trees generally have three definite advantages:

1. Closer to West Coast markets.

2. Brighter green color.

3. Stronger branch structure.

By concentrating on producing high quality trees, we should be able to more than hold our own against competition. Oregon and Washington have some of the best naturally suited areas in the world for growing Christmas trees.

E. PREHARVEST JOBS

1. An all-weather access road to the Christmas tree area is a "must". In addition, a system of parallel harvest roads should be located at 200 to 400 foot intervals throughout the cutting area to reduce dragging (tree carrying) costs. Moderate grades, culverts and gravelled surfaces generally save money in the long run.

2. Only light pruning or shearing should be done during the same year that the trees are to be harvested. Heavy shearing at this time may result in visible stubs and a cropped, unnatural appearance. However, removal of multiple leaders, suckers and unsymmetrical branches may raise the tree grade.

3. Chlorotic (yellowish) needles caused by a nitrogen deficiency can often be corrected by applying ammonium nitrate or other nitrogen fertilizer under the drip line of the tree. Best times to fertilize for color improvement are either early spring just before the buds burst or late August of the same year the tree will be cut. Spring application will stimulate both growth and color. Late summer application will stimulate only color. Required dosage per tree to get desired results depends on the nitrogen deficiency of the soil. Trials should be made with 1/8 to 3/4 pound (33% nitrogen fertilizer) per tree to determine the least amount that will give good color.

4. A complete inventory of marketable trees by species, height, and grade should be made. An accurate inventory is essential for planning and sale negotiation. The best time to make the inventory is at the same time the trees are marked for cutting.

5. Most growers prefer to make their own selection of trees to be harvested whether they do their own cutting, hire cutters, or sell trees on the stumps. Trees can be marked for cutting by spraying bright colored paint on the stem below the handle or by attaching a red plastic ribbon or other bright marker to a branch.

6. Some growers make the mistake of depleting their growing stock by marking too many smaller trees. They should keep in mind that about 80% of the demand is for 5- to 7-foot trees. Smaller trees should be largely from thinnings that will release crowded trees.

7. Trepass may be a problem for several months before Christmas. Signs and locked gates are inexpensive precautions and are usually effective. More costly precautions such as special fencing or watchman service may be necessary in problem areas. Growers should obtain the cooperation of local law enforcement officers.

SIGNS ARE AN EFFECTIVE METHOD OF REDUCING LOSS THROUGH TRESPASS.

8. The grower should be sure of a market before he harvests. Additional details appear under Section F on Marketing.

F. LICENSES, PERMITS AND OTHER LEGAL REQUIREMENTS

Detailed information on state, interstate, county and local regulations are available in the bulletin "Regulatory Measures Affecting the Cutting, Transporting and Marketing of Christmas Trees and Boughs Grown in Oregon" (with a similar one for Washington). Copies are available from farm foresters, county extension agents, or the U.S. Forest Service, Box 4137, Portland 8, Oregon. Some of the important regulations are summarized below:

1. Oregon

a. A Christmas Tree Harvesting Permit is required before any trees are cut commercially. It should be obtained from the local District Warden, Oregon State Board of Forestry.

b. A Bill of Sale is required while transporting more than 5 trees unless the landowner is doing the hauling. It must show the date, number and species of trees, legal description of cutting area and name and address of the buyer and seller.

c. A PUC Permit is required for private carriers with gross weights over 6,000 pounds.

d. Most cities require a permit or license for operating a retail lot.

2. Washington

a. A Cutting Permit is not required except on classified reforestation lands.

b. An annual report is required for all out-of-state shipments. Forms and information should be obtained from a District Office of the Department of Natural Resources.

c. Several Western Washington counties require Load Certificates for transporting more than 5 trees. Truckers not acquainted with these requirements may obtain information from the Department of Natural Resources or the County Sheriff. Load certificate forms can also be obtained free of charge at these offices.

d. A UTC Permit is not required for private carriers who own the trees that they haul.

e. A Temporary Registration Certificate is required for retailers. This should be obtained from the State Tax Commission. Collection of

a State retail sales tax is required. If gross sales are $600 or more per year, a business and occupation tax must be paid by both retailers and wholesalers.

f. Most cities require a permit or license for operating a retail lot.

G. HARVESTING

Proper time to harvest is determined by the condition of the needles, as well as timing for the market. Fall and early winter weather conditions are a determining factor as to when the needles have "hardened off" on the branches. If the trees are cut before this hardening-off period, they may shed their needles during storage and transit. A simple test for checking needle condition is described as follows: Grasp a cluster of needles firmly between the fingers and pull hard. If the needles strip easily from the twig, it is too early to cut the trees. If they break in two or strip off with great difficulty, the tree is ready to cut. At lower elevations, sufficient cold weather to set the needles may not occur until after December 1.

Harvesting on small areas may be done entirely by the grower with only a cruiser axe and pickup truck for equipment. A large grower on the other hand will have to hire cutters, draggers, loaders, drivers and also additional help if the trees are processed at his own concentration yard. Whether his operation is large or small, it does not pay the grower to get so bogged down in work and detail that his production schedule, marketing arrangements and general supervision of the entire operation are neglected. Mechanized equipment will often speed production and decrease the number of men needed. Regardless of the size of operation, basic procedures will apply. These are discussed below:

1. Cutting and Dragging

a. Cutters and draggers usually work in pairs. The cutter fells the trees and the dragger carries them to piles along the roadside. On large harvesting operations, a foreman assigns cutting strips to each pair, coordinates the cutting and inspects the work of each man. On small operations, one man may do both the cutting and dragging.

b. The cutter uses a short-handled pruning saw, light axe, or machete to cut trees. A saw is best if stump culture is a desired practice. In natural areas he may bunch several cut trees in a conspicuous place, such as the top of a stump or in a natural opening, to help the dragger spot them easily. Good handle length is about $1\frac{1}{2}$ inches for each foot of tree height. The cutter allows a few additional inches for trim. The handles later are sawed to proper length at the concentration area.

MANY CUTTERS USE A LIGHT CRUISER AXE. THE TREE IS BENT BACK TO PUT TENSION ON THE STEM AND FELLED WITH A SINGLE STROKE.

c. The cutter should be given clear instructions on which trees to cut. Pre-marking the trees that are to be cut is the surest way to accomplish the desired results. Most of the needed smaller sized trees can be harvested as thinnings to improve spacing and release crowded trees from competition. Cutters should be instructed on stump treatment. If stump culture is to be practiced to grow a future tree from a limb or sprout, a whorl or two of branches should be saved below the cut to keep the stump alive. However, stump culture is not usually practiced when sufficient smaller trees are already established to replace the trees that are cut.

STUMP CULTURE IS A GOOD PRACTICE WHERE NATURAL SEEDLINGS ARE SCARCE OR SLOW TO GET ESTABLISHED. WHEN THIS IS DONE, THE CUTTER LEAVES A FEW LIVE BRANCHES ON THE STUMP BELOW THE CUT.
A NEW CHRISTMAS TREE CAN BE DEVELOPED FROM ONE OF THE BRANCHES OR FROM A NEW SPROUT.

In this case the stump should be killed to reduce competition by cutting off all its limbs.

d. Draggers carry several trees, butt first, under each arm. Trees are easily damaged by rough handling. They should be held high enough to prevent scraping off needles and buds and soiling the needles. The dragger should work closely with the cutter and know the boundaries of the cutting strip to avoid missing cut trees. Trees are bunched in piles, butt first, alongside the road for easy loading onto a truck.

2. <u>Transportation, Processing, and Storage</u>

a. Trees piled along the roadside are loaded onto trucks, trailers or pickups and hauled to a central processing and shipping point known as a "concentration area".

"DRAGGERS" FOLLOW THE CUTTERS. THEY CARRY CUT TREES FROM THE WOODS AND BUNCH THEM IN PILES ALONG THE ROADSIDE.

THIS LOAD OF FRESHLY CUT DOUGLAS-FIR HAS JUST ARRIVED AT THE CONCENTRATION YARD. THE DRIVER IS FASTENING THE ENDS OF A CABLE TO A SOLID ANCHOR ON THE GROUND. WHEN HE DRIVES AHEAD SLOWLY, THE ENTIRE LOAD WILL SLIP OFF THE TRUCK BED ONTO THE GROUND.

b. Careful handling when the trees are loaded or unloaded is necessary to reduce breakage and rubbing off needles and buds. A good way to reduce rope abrasions and wind drying during transit is to pad the top and sides of the load with loose branches. The same branches can be used to protect the trees during storage at the concentration area. They may also be salable as Christmas decorations.

c. Processing for shipment:

(1) Trees are normally processed at the concentration area.

(2) In a few major Christmas tree producing areas, such as the South Puget Sound, wholesalers have their own concentration yards. Many such yards are highly mechanized for sorting, bundling, trimming, handling, and loading for rail or truck shipment. Most yards have buyers who will purchase delivered trees from local growers. Selling to an established concentration yard relieves the grower of both risk and processing responsibility.

LARGE CONCENTRATION YARDS, SUCH AS THIS ONE NEAR SHELTON, WASHINGTON, ARE HIGHLY MECHANIZED. THEY HANDLE THOUSANDS OF TREES EACH DAY. TREES ARE SHOWN PASSING UNDER A MIST SPRAY WHICH CONTAINS A FUNGICIDE IN WATER SOLUTION TO HELP CONTROL SPOILAGE DURING STORAGE AND TRANSIT.

OTHER CONCENTRATION AREAS, SUCH AS THIS ONE IN EASTERN OREGON, ARE SMALL ONE-MAN OPERATIONS SET UP AT THE FARM OR ON A VACANT LOT. THE OPERATOR HOPES TO REALIZE A GREATER DOLLAR RETURN BY PROCESSING HIS OWN TREES, OR TREES FROM LOCAL GROWERS, AND SELLING THEM DIRECTLY TO A RETAILER OR WHOLESALER.

(3) Many growers may not be near an established concentration yard or they may wish to realize a greater profit by processing and selling their own trees. In this case, they should set up their own concentration area. It can be in a vacant lot, back yard or open area at the Christmas tree farm, or any other place that is handy to transportation. It should be well protected and roomy enough for tree storage. The grower should sort the trees by species, length, and grade; trim the handle to proper length; remove excess or broken branches; and, when necessary, tie the trees in bundles.

(4) The main purpose of bundling is to make the trees more compact to reduce handling and shipping costs. It also reduces branch breakage. Normally, only trees with limber branches, such as Douglas-fir and pines, are bundled. The average number of trees per bundle for various tree sizes is shown below:

Tree Height in Feet	No. of Trees per Bundle
2- 3	8
3- 4	6
5- 6	4
7- 8	3
9-10	2
11-12	1

BUNDLERS MAKE THEIR JOB EASIER BY SUSPENDING THE TREES BETWEEN TWO SAW HORSES. BINDER TWINE IS USED TO TIE THE TREES INTO COMPACT BUNDLES.

Enough trees are placed on a sawbuck type of rack to make a bundle. The bundler first binds the handles of the trees together with a wrap of untreated binder twine. Working toward the tops of the trees, he then makes similar wraps at close intervals to compact the branches into a solid bundle. Handles are trimmed to length after the bundles have been tied.

d. After the trees have been processed at the concentration area, they should be stored in a protected spot until ready to ship by rail or truck.

e. The main causes of spoilage are overheating and dry winds. Overheating and mold can be prevented by an adequate circulation of cool air, by keeping piles shallow and separated, and by placing a layer of branches between the trees and the bare ground. Storage in closed buildings is always risky. Outdoor storage is recommended where the piles can be protected from the sun and drying winds. Good storage areas are under the shelter of trees or on the protected side of a building. Undesirable drying conditions are usually associated with cold weather and strong north or east winds. Drying can be reduced by windbreaks, covering the piles with branches, or sprinkling to conserve moisture.

H. MARKETING

The grower has three possible buyers for his trees:

Wholesaler

Retailer

Consumer

The grower should realize that each step nearer to selling directly to the consumer increases his opportunity for a greater profit, but at the same time increases his workload and risk of loss from unsold trees. This helps to explain why retail prices are frequently 3 to 5 times greater than the price the grower receives from a wholesaler. The grower with a large number of trees to sell usually does not have time to set up for retail selling. His time is occupied by culturing, harvesting, and transporting the trees to wholesalers or retailers. Profits depend on volume of sales rather than high profits per tree. A grower with only 500 or 1,000 trees to sell may have a different viewpoint. His workload is less and he may be willing to take on the required detail, hard work, and long hours of retail selling. By so doing, he may be able to double his net returns compared to selling the trees wholesale. Of course, the grower must consider many other factors in deciding whether to sell retail or wholesale. These include nearness to population centers, retailing experience, amount of capital available to start a retail yard, and personal preferences.

1. Selling to a Wholesaler or Retailer

a. Selling to a wholesaler at his concentration yard is common practice in major Christmas tree producing areas such as Mason and Kitsap Counties in Washington and Josephine and Lake Counties in Oregon. Although a few larger yards handle only trees cut from their own lands, most yards purchase at least a portion of their trees from other growers.

The grower should check with the yard manager before any trees are cut to obtain specifications on species, size, grade, price, and

delivery dates. Hauling trees to the yard is usually the responsibility of the grower who is paid on delivery. Sorting, grading, bundling, and shipping are handled at the concentration yard.

Some areas do not have concentration yards and it may be necessary for the grower to make special inquiries to locate a wholesale buyer. Wholesalers are continually looking for sources of high quality trees and will travel considerable distances to check a good prospect. Growers can make contacts with wholesale buyers through Christmas tree associations, farm foresters, county agents, U.S. Forest Service, newspaper advertisements, or yellow pages in telephone directories of important producing areas. Arrangements for harvesting, hauling and payment should be worked out with the wholesaler well in advance of cutting.

b. Many growers find it profitable and convenient to sell directly to a retailer, particularly when their production is small. Retailers, too, are constantly looking for sources of high quality, freshly cut trees. Once the grower has started to supply good trees to a reliable retailer, satisfactory selling arrangements may be continued year after year. A good way to obtain names and addresses of retailers for future reference is to contact them at their place of business in December. Smaller retailers may be hard to locate during the rest of the year, but larger established retailers can usually be contacted through local Christmas tree associations, farm foresters, county agents, or the U.S. Forest Service.

c. Buyers, whether they are wholesalers or retailers, should be contacted in late summer or early fall, well before the cutting season.

d. The Northwest Christmas Tree Association sponsors an annual trade fair. This provides good opportunity for growers to display samples of their trees and make contacts with buyers.

e. A signed agreement should be made between the grower and the buyer. For better assurance that both parties fully understand the requirements, the service of a forester or attorney is suggested. The sale agreement should clearly state the following applicable sale conditions:

(1) Quantity of trees sold by species, size, and possibly grade.

(2) Legal land description, clearly described cutting area boundaries, and description of trees to be cut. Sold trees should also be plainly marked or designated on the ground to protect both buyer and seller.

(3) Price per tree or per lineal foot and conditions of payment.

(4) Date to start cutting and termination date of agreement.

(5) Party responsible for doing and paying for the cutting, dragging, and transportation to the place of delivery.

(6) Handle length.

(7) Place and date of delivery.

(8) Any special requirements or conditions such as slash disposal, stump treatments,protection

of uncut trees, right to use roads, repair to damaged improvements, or bond to guarantee contract performance.

f. The most desirable selling arrangement is to get a cash payment in full when the sale is made. The most lenient payment terms the grower should accept is 50% of the total payment at the time the sale agreement is made with the balance to be paid before the trees are cut or delivered. This requirement will not discourage adequately financed buyers. It will discourage last-minute order cancellations, price down-grading and poor credit risks. Shipping trees on consignment to any buyer is a very risky way to do business and is not recommended.

Some buyers prefer to cut and drag trees with their own crews. In this case they buy "stumpage" which means uncut trees. However, a grower can usually realize 25¢ to 50¢ more per tree and have better control over the cutting practices if he does his own work.

g. If the grower agrees to transport the trees to a point of delivery, he should make proper allowance for this in his selling price. Hauling distance and type of road will influence cost.

h. The grower is obligated to fulfill his part of the agreement, the same as the buyer. He can establish a good business reputation by delivering on time, keeping the trees in good condition and delivering exactly what he promised.

2. Selling Trees to the Consumer

The grower has two possible outlets for selling his trees directly to the consumer: a retail lot or a choose-and-cut operation.

a. Retail Lots

Here are some tips for the grower who is planning to set up his own retail lot:

(1) The lot should be located only in population centers. Large cities or densely populated suburbs are best bets. The lot should be near heavily traveled main streets where the traffic flow is slow. Special attention should be given to adequate parking facilities. Good prospects are near supermarket parking lots, large shopping centers and on vacant lots at important crossroads. Past success of other retailers in the same location will help the grower judge his own chances.

(2) The lot rental agreement should be completed in writing well before December. Advance arrangements should also be made for electric service, night lighting, house trailer, sanitary facilities, tree stands, sawdust walkways, signs, and displays. Most lots are opened the second weekend in December. All preparations and arrangements should be completed by this time.

(3) Mounting the trees for display is always a major problem, especially in windy locations. A successful method is as follows: Drive 2" x 2" x 30" stakes into the ground about 6 to 8 feet apart. A shallow hole slightly larger in diameter than the handle of the tree is punched into the ground at the base of the stake. The handle is placed in the hole and the stem is bound firmly to the stake with binder twine or soft wire just above the bottom whorl. On hard or surfaced

lots, the trees may be mounted in wooden frame racks, tied to a heavy wire stretched between poles, or mounted in individual concrete slab stands with a hole through the center to hold the handle. Trees are held firmly in the slab by means of small wooden wedges. Lightweight stands are satisfactory only in protected or enclosed areas. The slightest wind will tip the trees over.

(4) Trees should be segregated by species and displayed in separate areas of the lot. Trees should also be arranged according to height. Tall trees should be in the background so as not to hide the shorter trees. Many successful retailers keep a small number of choice trees prominently displayed as "eye catchers" to attract passing drivers or pedestrians. "High grading" can be controlled by setting a higher price for choice trees than for average trees.

(5) Trees from 5 to 7 feet in height will likely comprise more than 80% of total sales. A few taller trees from 9 to 12 feet in height are sold for larger homes, commercial displays, and outdoor displays. Two to 4-foot trees are in demand for trailer homes, table trees, or second trees for the children's room.

(6) A variety of species from which to choose provides customer appeal. Douglas-fir is the best seller on most lots. Other good species to stock on a retail lot are concolor fir, grand fir, noble fir and shore pine. Production by species in Oregon and Washington is tabulated on page 3.

(7) Consumer studies show that the three most important characteristics of a good tree, in order of importance, are:

(a) Bushiness

(b) Good, symmetrical shape

(c) Freshly cut appearance.

(8) The retailer who grows his own trees is in a good position to offer and advertise freshly cut trees. This is a strong selling point with many buyers. Fresh trees can be kept in stock by cutting a new supply each week. This method of cutting has an additional advantage of keeping supply and demand in better balance to prevent large numbers of unsold trees.

(9) Protection of trees from drying and overheating is sometimes difficult on the lot. It may be safer to store undisplayed or newly delivered trees where they can be kept in good condition and bring small quantities at a time to the lot.

(10) Retail prices vary a great deal with species, tree quality, lot location, and local competition. Average 1960 prices for a 6-foot U.S. No. 1 tree in metropolitan areas of Western Oregon and Washington were approximately as follows:

Species	Range	Average
Douglas-fir	\$2.00-\$4.50	\$3.00
Noble and silver fir	5.00-10.00	6.00
Lodgepole & shore pine	4.00- 6.00	5.00
Grand and concolor fir	3.50- 6.00	4.50

Low quality trees, by contrast, sold for as low as $1.00 per 6-foot tree. Practically all lots cut prices a few days before Christmas to help liquidate surplus stock. An unsold surplus of 15% to 20% of total inventory is normal for most lots.

(11) Boughs, especially noble fir, are the most popular sideline item. Wreaths, door swags, mistletoe, and cones are also popular.

(12) Painted and flocked trees have been handled by some of the larger retail lots. Lots that handled them reported that flocked trees averaged 5% of their total sales and painted trees averaged 8% of their total sales. Favorite color was white, followed by blue. Flocked Douglas-fir sold for about $2.00 per foot, painted Douglas-fir for about $1.00 per foot.

(13) Live trees, potted in gallon cans, have comprised only a very minor part of total sales but are growing more popular. Favorite species are noble fir and shore pine. Price is about 2½ times greater than for a cut tree.

(14) The average customer is not an expert on tree species but he is very much aware of the quality. Some like to browse; others like to be helped with their selection. Like customers the world over, Christmas tree purchasers appreciate courtesy, sincerity, and wishes for a "Merry Christmas".

b. Choose-and-cut Christmas Tree Farms

These offer special appeal to families who make cutting their own tree a traditional event. It also insures a freshly cut tree without having to trespass. From the grower's viewpoint, this method of marketing gives the best possible assurance of selling every tree that is cut. Prices are generally about the same as those on retail lots.

Here are some tips for the grower who is thinking about setting up an operation in which the customer selects and cuts his own tree at the Christmas tree farm:

(1) This type of operation should be within reasonable driving distance from large population centers.

(2) The more species that are offered, the greater the customer appeal.

(3) Intensive advertising is especially important in the early stages of the business, until steady customers are attracted. Posters and advertising in local papers, TV, and radio are helpful. A feature story in a local newspaper is probably the best and certainly the least costly means of publicity.

(4) Large lettered signs with arrows pointing to the tree farm should be posted at road junctions. The landowner's permission should be obtained before the signs are posted. After Christmas the signs can be taken down and stored.

(5) Adequate parking space, turnouts and turnaround spots are necessary. Roads and parking spaces should be gravelled and well drained.

"CHOOSE-AND-CUT" RETAIL OPERATIONS ARE BECOMING MORE POPULAR EACH YEAR. THE PURCHASER CAN SELECT AND CUT HIS OWN TREE.

(6) Good access trails should be provided in cultured, natural areas. Trails should be located to form a loop pattern so that all trails lead back to the parking area. Trail signs are helpful.

(7) A comfortable, well-heated shelter should be constructed near the parking area for the comfort of the customers and for conducting business. Toilet facilities should be provided.

(8) A customer going out to cut his tree should be provided with a handsaw. Information on available species, prices and any special cutting requirements can be posted on prominently displayed signs or in leaflet handouts.

(9) A customer returning to the shelter should check in his saw and have his tree measured for payment. Free services such as hot coffee, candy favors for the children, recorded Christmas carols, assistance in carrying the tree to the car, and binder twine to tie down trunk lids create goodwill at no great cost.

(10) Other items such as boughs, wreaths, door swags, cones, and yule logs are profitable sidelines. They should be prominently displayed.

3. Christmas Tree Grades

The Agricultural Marketing Service of the U.S. Department of Agriculture has established three standard grades for Christmas trees: U.S. Premium, U.S. No. 1 and U.S. No. 2. Use of this system is optional. A bulletin, "U.S. Standards for Christmas Trees", and information on grading services can be obtained from offices of the Agricultural Marketing Service. Grade descriptions are summarized on page 16.

Although not yet widely accepted by the industry, the U.S. Standard grades do establish a sound basis for determining quality and price. Several of the larger Christmas tree companies have been using their own grading system for a number of years. Industry-wide acceptance of a standard grading system would benefit both buyers and sellers by enabling them to talk in common terms when negotiating a sale.

U.S. Standards for Christmas Trees

Grade	Density	Taper	Balance	Foliage	Deformities
	Required Standards for Grade				
U.S. Premium	Medium	Normal	4 complete faces	Fresh, clean & healthy	Not more serious than minor
U.S. No. 1	Medium	Normal (flaring or candlestick if tree is otherwise U.S. Premium)	3 complete faces	Fresh, clean & healthy	Not more serious than minor (noticeable deformation permitted if tree is otherwise U.S. Premium)
U.S. No. 2	Light	Normal (flaring or candlestick if tree is otherwise U.S. No. 1)	2 complete faces	Fresh, fairly clean, and free from damage	Not more serious than minor (noticeable deformities permitted if tree is otherwise U.S. No. 1)

I. SUMMING UP

The success of a christmas tree operation must be measured by net profits that the grower earns on his investment. Profits can never be taken for granted even when trees are of high quality. Christmas trees are an unusual product since they are both perishable and in short seasonal demand. This makes it especially important for growers to make sound harvesting and marketing plans well before the trees are cut. They must provide sufficient management, manpower and equipment to meet a brief and busy harvesting schedule. Long hours of hard work, know-how and willingness to take a financial risk are also necessary. Harvesting and marketing practices may determine the difference between profit and loss to the grower.

J. SOURCES OF ASSISTANCE AND INFORMATION

Services of a farm forester are available to most woodland areas in Oregon and Washington. The office address of the local farm forester can be obtained by inquiring at any State District Warden's office in Oregon or State Department of Natural Resources' office in Olympia, Washington.

Reference material is available from the County Extension Agent. He can also advise growers concerning the availability of assistance from farm foresters, extension foresters and others who work with Christmas tree growers.

Additional sources of harvesting and marketing information are:

Extension Forester, Agricultural Extension Service, Western Washington Experiment Station, Puyallup, Wash.

Extension Forester, Forestry 205. O. S. U., Corvallis, Oregon.

Extension Forester, Agricultural Extension Service, Washington State University, Pullman, Washington.

Local offices of the Soil Conservation Service.

U. S. Forest Service, P.O. Box 4137, Portland, Oregon.

Northwest Christmas Tree Association. (The name and address of the current secretary may be obtained by contacting a farm forester or the U.S. Forest Service at the above address.)

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

PACIFIC NORTHWEST REGION—STATE AND PRIVATE FORESTRY

PORTLAND, OREGON

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CHRISTMAS TREE HARVESTING AND MARKETING FOR PACIFIC NORTHWEST GROWERS

CONTENTS Page

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ers Northwest Christmas Tree
ciation.

FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

I. INTRODUCTION

Harvesting and marketing are of vital concern to the Christmas tree grower. For 7 to 12 years he has invested a considerable amount of money and many hours of nard work culturing his trees into masterpieces of beauty. Yet the success or failure of his entire venture is determined by sales returns during a period of a few weeks. It is not surprising that successful marketing requires the same degree of skill, effort and advance planning by the grower as is needed to culture a field of scraggly seedlings into high quality Christmas trees.

Christmas trees are unique as a commodity. For 11 months of the year they have little or no retail value. Then they suddenly become a valuable item of trade as some 40 million American buyers eagerly seek the tree of their choice. Just as suddenly, the Christmas season passes and cut trees become a liability, for it costs money to haul debris away.

The purpose of this bulletin is to provide guides which may be helpful to the grower during the brief, but important, harvesting and marketing period.

II. CONSUMER DEMANDS

A. QUALITY IS A "MUST"

No amount of skilled merchandising will enable a seller to get top pric unless his trees are of top quality. Many retail lots are overstocked wit spindly, sparsely branched saplings that should have been left in the forest. Unsold trees on Christmas D are usually of this quality. Grower wholesalers and retailers who fail t set their sights on high quality wil drop by the wayside as competition f markets becomes keener. In the long run it is the customer who sets the standards for quality. Most custome will not purchase poor quality trees when better trees are available.

Consumer studies show that the three most important characteristics of a good tree, in order of importance, a

1. Bushiness
2. Good, symmetrical shape
3. Freshly cut appearance

B. SPECIES

The demand for the old stand-bys, Douglas-fir, concolor fir, grand fir and noble fir is likely to remain

Estimated Christmas Tree Production in the Pacific Northwest in 1963

Species	Oregon	Washington	Total	%
	Number of Trees			
Douglas-fir	600,000	2,750,000	3,350,000	83%
Concolor &) Grand fir)	300,000	50,000	350,000	9%
Noble, Silver & Shasta red firs	150,000	20,000	170,000	4%
Lodgepole &) Shore pines)	100,000	20,000	120,000	3%
Spruces, Ponderosa pine, White pine & other species	10,000	20,000	30,000	1%
Totals	1,160,000	2,860,000	4,020,000	100%

m for many years. Demand for Scotch, re and bishop pine has been increas- during the past few years. Prob- y these, and other exotic species, l continue to gain in popularity.

er species, such as spruce, redwood, ar, hemlock and ponderosa pine have er accounted for a very sizeable tion of our total production. tain characteristics of these species long established buying habits of tomers make it doubtful that the and will increase in the near future.

. PREHARVEST JOBS

A. SPRING

1. Thinning. Trees do not elop properly if they grow so sely together that their branches ch. Trees should be sufficiently nned before the growing season to ow for expansion of new growth.

2. Dormant Shearing. Trees h uneven taper, lopsided crowns, essive width, or excessively long ders should be sheared to a good pe before spring growth begins. n this is done, only light summer aring will be needed for the final ping before harvest.

3. Fertilizing. Yellowish lorotic) needles are usually caused a nitrogen deficiency in the soil. s can be corrected by scattering lets of a nitrogen fertilizer, such rea or ammonium nitrate, under the lines of individual trees. Apply April or May before the buds burst. ke trial applications of 1/8 to 1/4 pound (actual nitrogen weight) tree. This will determine the st amount that will produce a en color by November of the am year.

l those trees planned for harvest ring the current year should be rilized. When fertilized trees re allowed to grow for more than one eaon, they are likely to produce xcssive growth. Also, the color mpovement is less pronounced after he first winter.

B. SUMMER

1. Construct or Repair Roads. An all-weather access road to the Christmas tree area is a "must". In addition, a system of parallel harvest roads should be located at 200- to 400-foot intervals throughout the cutting area to reduce dragging (tree carrying) costs. Moderate grades, culverts and gravelled surfaces generally save money in the long run.

2. Light Succulent Shearing. Imperfectly-shaped trees should be lightly, but skillfully sheared during the summer before harvest. Heavy shearing at this time will produce visible stubs and a cropped, unnatural appearance.

Pines should be sheared during a four-week period beginning about the middle of June when new growth is fully elongated but still succulent. Shearing of firs and spruces may begin at the same time and continue until the last of August.

C. FALL

1. Inventory. A complete inventory of marketable trees by species, height and grade should be made. An accurate inventory is essential for planning and sale negotiation. The best time to make the inventory is at the same time the trees are marked for cutting.

2. Mark for Cutting. Most growers prefer to make their own selection of trees to be harvested whether they do their own cutting, hire cutters, or sell trees on the stumps. Trees can be marked for cutting by spraying bright colored paint on the stem below the handle or by attaching a red plastic ribbon or other bright marker to a branch.

Do not make the mistake of depleting your growing stock by marking too many smaller trees. Keep in mind that about 80% of the demand is for 5- to 7-foot trees. Smaller trees should be cut mostly from thinnings that will release crowded trees.

Signs effectively reduce trespass loss.

3. Sign or Gate. Trespas may be a problem for several months before Christmas. Signs and locked gates are inexpensive precautions an are usually effective. More costly precautions such as special fencing or watchman service may be necessary in problem areas. Growers should obtain the cooperation of local law enforcement officers.

4. Line Up Market. Be sure of a market before harvestin See Section VI, MARKETING.

IV. LEGAL REQUIREMENTS

Requirement	When Required	Where Obtained
A. OREGON		
Permit to Harvest	All Commercial Cutting	State Forester,Dist Warden, or Ranger S
Bill of Sale	Transporting More than 5 trees	From Owner
P.U.C. Permit	Over 6,000# Gross Weight	P.U.C. Office
Tax Report	Cutting from Private Land	County Tax Assessor
Special Cutting Permit	Cutting from Classified Reforestation Lands	State Tax Commissio
Retail License or Permit	Most Cities	City Hall
B. WASHINGTON		
Cutting Permit	Only on Classified Reforestation Lands	Dept. of Natural Re
Annual Shipment Report	All Out-of-State Shipments	" " " "
Load Certificates	Transporting more than 5 trees--some counties only	Sheriff's Office, or Dept. of Nat. Res
U.T.C. Permit	Contract Haulers Only	U.T.C. Office
Registration Certificate	All Retailers	State Tax Commission
Retail License or Permit	Most Cities	City Hall

HARVESTING

oper time to harvest is determined the condition of the needles, as ll as timing for the market. Fall d early winter weather conditions e a determining factor as to when e needles have "hardened off" on e branches. If the trees are cut fore this hardening-off period, ey may shed their needles during orage and transit. A simple test r checking needle condition is scribed as follows: Grasp a cluster needles firmly between the fingers d pull hard. If the needles strip sily from the twig, it is too early cut the trees. If they break in o or strip off with great difficulty, e tree is ready to cut. At lower evations, sufficient cold weather set the needles may not occur until ter December 1.

rvesting on small areas may be done irely by the grower with only a / or axe and pickup truck for equip-t. A large grower will have to e cutters, draggers, loaders, vers and additional help if the es are processed at his own concen-tion yard. Whether his operation large or small, it does not pay the wer to get so bogged down in work detail that his production sched-, marketing arrangements and eral supervision of the entire oper-on are neglected. Mechanized ipment will often speed production decrease the number of men needed. ardless of the size of operation, ic procedures will apply. These discussed below:

A. CUTTING AND DRAGGING

1. Cutters and draggers ally work in pairs. The cutter ls the trees and the dragger ries them to piles along the road-e. On large harvesting operations, reman assigns cutting strips to a pair, coordinates the cutting c inspects the work of each man. mall operations, one man may do ot the cutting and dragging.

2. The cutter uses a short-handled saw or light axe to cut trees. A saw is best if stump culture is a desired practice or handles are to be cut squarely to the exact desired length. In natural areas he may bunch several cut trees in a conspicuous place, such as the top of a stump or in a natural opening, to help the dragger spot them easily. Good handle length is usually about 1 to 1-1/2 inches for each foot of tree height. The cutter allows a few additional inches for trim if the handles are later to be sawed to proper length at the concentration area.

"Draggers" follow the Cutters. They carry cut trees from the woods and bunch them in piles along the roadside.

B. TRANSPORTING TO YARD.

1. Trees piled along the road-side are loaded onto trucks, trailers or pickups and hauled to a central processing and shipping point known as a "concentration area".

2. Careful handling when the trees are loaded or unloaded is neces-sary to reduce breakage and rubbing off needles and buds. A good way to reduce rope abrasions and wind drying during transit is to pad the top and

sides of the load with loose branches. The same branches can be used to protect the trees during storage at the concentration area. They may also be salable as Christmas decorations.

This load of freshly cut Douglas-fir has just arrived at the concentration yard. The driver is fastening the ends of a cable to a solid anchor on the ground. When he drives ahead slowly, the entire load will slip off the truck bed onto the ground.

C. PROCESSING

1. Trees are normally processed at the concentration area.

2. In a few major Christmas tree producing areas, such as the South Puget Sound, wholesalers have their own concentration yards. Many such yards are highly mechanized for sorting, bundling, trimming, handling, and loading for rail or truck shipment. Most yards have buyers who will purchase delivered trees from local growers. Selling to an established concentration yard relieves the grower of both risk and processing responsibility.

Large concentration yards, such as this one near Shelton, Washington, are highly mechanized. They handle thousands of trees each day. Trees are shown passing under a mist spray which contains a fungicide in water solution to help control spoilage during storage and transit.

Other concentration areas, such as this one in Eastern Oregon, are small one-man operations set up at the farm or on a vacant lot. The operator hopes to realize a greater dollar return by doing his own processing locally.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
PACIFIC NORTHWEST REGION
POST OFFICE BOX 3623
PORTLAND, OREGON 97208

IN REPLY REFER TO

1630

March 1, 1965

We are sending you a revised copy (or copies) of Managing Your Woodland --How to Do It Guide No. 8, "Christmas Tree Harvesting and Marketing for Pacific Northwest Growers".

We gave this pamphlet a new look as well as updating the material.

Additional copies are available in the Division of State & Private Forestry.

Sincerely yours,

E. H. Marshall

E.H. MARSHALL
Assistant Regional Forester

3. Many growers may not be ear an established concentration rd or they may wish to realize a eater profit by processing and sell- g their own trees. In this case, ey should set up their own concen- ation area. It can be in a vacant t, back yard or open area at the ristmas tree farm, or any other ace that is handy to transportation. should be well protected and roomy ough for tree storage. The grower ould sort the trees by species, ngth, and grade; trim the handle proper length; remove excess or oken branches; and, when necessary, e the trees in bundles.

4. The main purpose of bun- ing is to make the trees more pact to reduce handling and ship- ig costs. It also reduces branch akage. Normally, only trees with iber branches, such as Douglas-fir pines, are bundled. The average ber of trees per bundle for vari- tree sizes is shown below:

Tree Height in feet	No. of Trees per bundle
2 - 3	8
3 - 4	6
5 - 6	4
7 - 8	3
9 -10	2
11 -12	1

ındlers make their jobs easier y suspending the trees between o sawhorses. Binder twine used to tie the trees into mpact bundles.

Enough trees are placed on a sawbuck type of rack to make a bundle. The bundler first binds the handles of the trees together with a wrap of untreated binder twine. Working toward the tops of the trees, he then makes similar wraps at close intervals to compact the branches into a solid bundle. Handles are trimmed to length after the bundles have been tied.

D. STORAGE

1. After the trees have been processed, they should be stored in a protected spot until ready to ship by rail or truck.

2. The main causes of spoilage are overheating and dry winds. Over- heating and mold can be prevented by an adequate circulation of cool air, keeping piles shallow and separa- ted, and by placing a layer of branches between the trees and the bare ground. Storage in closed buildings is always risky. Outdoor storage is recommended where the piles can be protected from the sun and drying winds. Good storage areas are under the shelter of trees or on the protected side of a building. Undesirable drying conditions are usually associated with cold weather and strong north or east winds. Drying can be reduced by windbreaks, covering the piles with branches, or sprinkling to conserve moisture.

VI. MARKETING

The grower has three possible buyers for his trees:

Wholesaler

Retailer

Consumer

The grower should realize that each step nearer to selling directly to the consumer increases his opportunity for a greater profit, but at the same time increases his workload and risk of loss from unsold trees.

This helps to explain why retail prices are frequently 3 to 5 times greater than the price the grower receives from a wholesaler. The grower with a large number of trees to sell usually does not have time to set up for retail selling. His time is occupied by culturing, harvesting, and transporting the trees to wholesalers or retailers. Profits depend on volume of sales rather than high profits per tree. A grower with only 500 or 1,000 trees to sell may have a different viewpoint. His workload is less and he may be willing to take on the required detail, hard work, and long hours of retail selling. By so doing, he may be able to double his net returns compared to selling the trees wholesale. Of course, the grower must consider many other factors in deciding whether to sell retail or wholesale. These include nearness to population centers, retailing experience, amount of capital available to start a retail yard, and personal preferences.

A. SELLING TO A WHOLESALER

1. Selling to a wholesaler at his concentration yard is common practice in major Christmas tree producing areas such as Mason and Kitsap Counties in Washington and Josephine and Lake Counties in Oregon. Although a few larger yards handle only trees cut from their own lands, most yards purchase at least a portion of their trees from other growers.

The grower should check with the yard manager before any trees are cut to obtain specifications on species, size, grade, price, and delivery dates. Hauling trees to the yard is usually the responsibility of the grower who is paid on delivery. Sorting, grading, bundling, and shipping are handled at the concentration yard.

Some areas do not have concentration yards and it may be necessary for the grower to make special inquiries to locate a wholesale buyer. Wholesalers are continually looking for sources of high quality trees and will travel considerable distances to check a g prospect. Growers can make contact with wholesale buyers through Chris mas tree associations, farm foreste county agents, U.S. Forest Service, newspaper advertisements, or yellow pages in telephone directories of important producing areas. Arrange for harvesting, hauling and payment should be worked out with the whole well in advance of cutting.

B. SELLING TO A RETAILER

Many growers find it profitable and convenient to sell directly to a retailer, particularly when their production is small. Retailers, to are constantly looking for sources high quality, freshly cut trees. C the grower has started to supply go trees to a reliable retailer, satis tory selling arrangements may be co tinued year after year. A good way obtain names and addresses of retai for future reference is to contact at their place of business in Decem Smaller retailers may be hard to lo during the rest of the year, but la established retailers can usually b contacted through local Christmas tree associations, farm foresters, county agents, or the U.S. Forest Service.

Buyers, whether they are wholesaler or retailers, should be contacted i late summer or early fall, well bef the cutting season.

The Northwest Christmas Tree Associ sponsors an annual trade fair. Thi provides good opportunity for growe to display samples of their trees a make contacts with buyers.

C. AGREEMENTS

1. A signed agreement shou be made between the grower and the buyer. For better assurance that b parties fully understand the requir ments, the service of a forester or attorney is suggested. The sale ag ment should clearly state the follow applicable sale conditions.

a. Quantity of trees sold by species, size, and possibly grade.

b. Legal land description, clearly described cutting area boundaries, and description of trees to be cut. Sold trees should also be plainly marked or designated on the ground to protect both buyer and seller.

c. Price per tree or per lineal foot and conditions of payment.

d. Date to start cutting and termination date of agreement.

e. Party responsible for loing and paying for the cutting, lragging, and transportation to the lace of delivery.

f. Handle length.

g. Place and date of elivery.

h. Any special requireents or conditions such as slash isposal, stump treatments, protecion of uncut trees, right to use oads, repair to damaged improvements, r bond to guarantee contract rformance.

2. The most desirable selling arrangement is to get a cash payment i full when the sale is made. The mst lenient payment terms the grower sould accept is 50% of the total pyment at the time the sale agreement i made with the balance to be paid bfore the trees are cut or delivered. Tis requirement will not discourage aequately financed buyers. It will dscourage last minute order cancel-ltions, price downgrading and poor cedit risks. Shipping trees on cnsignment to any buyer is a very rsky way to do business and is not rcommended.

Sne buyers prefer to cut and drag tres with their own crews. In this cse they buy "stumpage" which means unut trees. However, a grower can usualy realize 25¢ to 50¢ more per tree and have better control over the cutting practices if he does his own work.

3. If the grower agrees to transport the trees to a point of delivery he should make proper allowance for this in his selling price. Hauling distance and type of road will influence cost.

4. The grower is obligated to fulfill his part of the agreement, the same as the buyer. He can establish a good business reputation by delivering on time, keeping the trees in good condition and delivering exactly what he promised.

D. SELLING ON A RETAIL LOT

Here are some tips for the grower who is planning to set up his own retail lot:

1. The lot should be located only in population centers. Large cities or densely populated suburbs are best bets. The lot should be near heavily traveled main streets where the traffic flow is slow. Special attention should be given to adequate parking facilities. Good prospects are near supermarket parking lots, large shopping centers and on vacant lots at important crossroads. Past success of other retailers in the same location will help the grower judge his own chances.

2. The lot rental agreement should be completed in writing well before December. Advance arrangements should also be made for electric service, night lighting, house trailer, sanitary facilities, tree stands, sawdust walkways, signs, and displays. Most lots are opened the second week end in December. All preparations and arrangements should be completed by this time.

3. Mounting the trees for display is a major problem, especially in windy locations. A good method on unsurfaced lots is to tie the handle of the tree to stakes driven into the ground about 6 to 8 feet apart. On

hard or surfaced lots, the trees may be mounted in wooden frame racks, tied to a heavy wire stretched between poles, or mounted in individual concrete slab stands with a hole through the center to hold the handle. Trees are held firmly in the slab by means of small wooden wedges. Lightweight stands are satisfactory only in protected or enclosed areas. The slightest wind will tip the trees over.

4. Trees should be segregated by species and displayed in separate areas of the lot. Trees should also be arranged according to height or price. Many successful retailers keep a small number of choice trees prominently displayed as "eye catchers" to attract passing drivers or pedestrians. "High grading" can be controlled by setting a higher price for choice trees than for average trees.

5. Trees from 5 to 7 feet in height will likely comprise more than 80% of total sales. A few taller trees from 9 to 12 feet in height are sold for larger homes, commercial displays, and outdoor displays. Two to 4-foot trees are in demand for trailer homes, table trees, or second trees for the children's room.

6. A variety of species from which to choose provides customer appeal. Douglas-fir is the best seller on most lots. Other good species to stock on a retail lot are noble fir, grand fir, Scotch pine and shore pine. Production by species in Oregon and Washington is tabulated on page 2.

7. The retailer who grows his own trees is in a good position to offer and advertise freshly cut trees. This is a strong selling point with many buyers. Fresh trees can be kept in stock by cutting a new supply each week. This method of cutting has an additional advantage of keeping supply and demand in better balance to prevent large numbers of unsold trees.

8. Protection of trees from drying and overheating is sometimes difficult on the lot. It may be saf to store undisplayed or newly delive trees where they can be kept in good condition and bring small quantities at a time to the lot.

9. Retail prices vary a gre deal with species, tree quality, lot location, and local competition. Average 1964 prices for a 6-foot U.S No. 1 tree in metropolitan areas of Western Oregon and Washington were approximately as follows:

Species	Range	Average
Douglas-fir	\$2.00-\$5.00	\$3.50
Noble and silver fir	5.00-10.00	7.00
Lodgepole & shore pine	4.00- 7.00	5.00
Grand and concolor fir	4.00- 7.00	5.00

Low quality trees, by contrast, sold for as low as \$1.00 per 6-foot tree. Practically all lots cut prices a fe days before Christmas to help liquid surplus stock. An unsold surplus of 15% to 20% of total inventory is normal for most lots.

10. Boughs, especially noble fir, are the most popular sideline item. Wreaths, door swags, mistleto and cones are also popular.

11. Some retailers find that including painted and flocked trees will increase their profits. Painte trees may be displayed on an open lo but flocked trees require protection from the weather. Prices of painted trees are about double, and flocked trees about triple those of natural trees. Favorite colors are white an pale blue.

12. Live trees, potted in gallon cans, have comprised only a very minor part of total sales but a growing more popular. Favorite spec are noble fir and shore pine. Price about 2½ times greater than for a cut tree.

13. The average customer is not an expert on tree species but he is very much aware of the quality. Some like to browse; others like to be helped with their selection. Christmas tree purchasers appreciate courtesy, sincerity and wishes for a "Merry Christmas".

E. CHOOSE-AND-CUT CHRISTMAS TREE FARMS

These offer special appeal to families who make cutting their own tree a traditional event. It also insures a freshly cut tree without having to trespass. From the grower's viewpoint, this method of marketing gives the best possible assurance of selling every tree that is cut. Prices are generally about the same as those on retail lots.

"Choose-and-Cut" Retail Operations are becoming more popular each year. The purchaser can bring his family to select and cut their own tree.

'ollowing are some tips for the grower 'ho is thinking about setting up an 'peration in which the customer selects nd cuts his own tree at the Christmas ree farm.

1. Locate within reasonable driving distance from large population centers.

2. The more species that are offered, the greater the customer appeal.

3. Intensive advertising is especially important in the early stages of the business, until steady customers are attracted. Posters and advertising in local papers, TV,and radio are helpful. A feature story in a local newspaper is an effective means of publicity.

4. Large lettered signs with arrows pointing to a tree farm should be posted at road junctions. The landowner's permission should be obtained before the signs are posted. After Christmas the signs can be taken down and stored.

5. Adequate parking space, turnouts and turnaround spots are necessary. Roads and parking spaces should be gravelled and well drained.

6. Good access trails should be provided in cultured, natural areas. Trails should be located to form a loop pattern so that all trails lead back to the parking area. Trail signs are helpful.

7. A comfortable, well-heated shelter should be constructed near the parking area for the comfort of the customers and for conducting business. Toilet facilities should be provided.

8. A customer going out to cut his tree should be provided with a handsaw. Information on available species, prices and any special cutting requirements can be posted on prominently displayed signs or in leaflet handouts.

9. A customer returning to the shelter should check in his saw

and have his tree measured for payment. Services such as hot coffee, candy favors for the children, recorded Christmas Carols, assistance in carrying the tree to the car, and binder twine to tie down trunk lids create goodwill at no great cost.

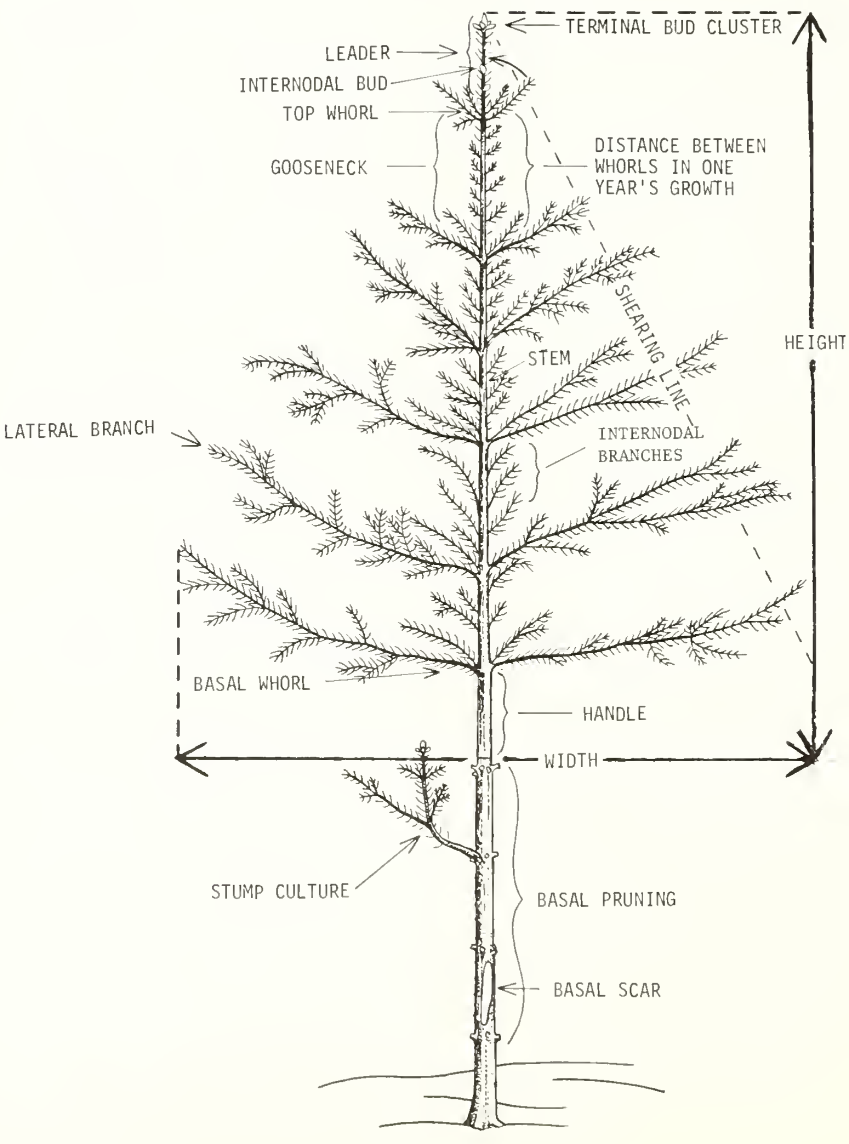
10. Other items such as boughs, wreaths, door swags, cones, and yule logs are profitable sidelines. They should be prominently displayed.

VII. CHRISTMAS TREE GRADES

The Agricultural Marketing Service of the U.S. Department of Agriculture has established three standard grades for Christmas trees: U.S. Premium, U.S. No. 1 and U.S. No. 2. Use of this system is optional. A bulletin, "U. Standards for Christmas Trees", and information on grading services can obtained from offices of the Agricultural Marketing Service. Grade descriptions are summarized on page 13

Although not yet widely accepted by industry, the U.S. Standard grades d establish a sound basis for determining quality and price. Several of t larger Christmas tree companies have been using their own grading system for a number of years. Industry-wid acceptance of a standard grading sys would benefit both buyers and seller by enabling them to talk in common terms when negotiating a sale.

CHRISTMAS TREE TERMINOLOGY



U. S. Standards for Christmas Trees

	Required Standards for Grade				
Grade	Density	Taper	Balance	Foliage	Deformities
.S. Premium	Medium	Normal 40-90% for pines 40-70% other species	4 faces free from damage	Fresh, clean healthy & well trimmed	Minor only
.S. No. 1 or .S. Choice	Medium	Normal	3 faces free from damage	Fresh, clean healthy & well trimmed	Minor only (noticeable deformation permitted if tree is otherwise U.S.Prem.
.S. No. 2 or .S.Standard	Light	Normal flaring or candlestick	2 adjacent faces free from damage	Fresh,fairly clean,healthy & well trimmed	Minor only (noticeable deformities permitted if tree is otherwise U.S. No. 1

finitions:

per: Relation of tree width to tree height, expressed as a percentage.

ee Height: Distance from bottom of handle to top of leader, provided that handle is approximately one inch for each foot of tree height and leader length is proportional to overall tree height.

ce: The visible surface area of the tree viewed at a distance of 8 to 10 feet from the tree. A tree has four faces.

nage: Any specific noticeable defect which distracts from the appearance or shipping quality. These include goosenecks, uneven density, broken branches, weak branches, barren lower whorls, curved stems, holes in foliage, excessively long leaders, incomplete whorls, handles not proportional to tree height, multiple leaders, dead twigs, loss of needles, abnormal appearing needles, and excessive moss, lichens, or other foreign material.

VIII. A LOOK INTO THE FUTURE

Is there a danger of overproduction? Growers in the East are already facing this problem. However, where overproduction has become a problem, growers of high quality trees have found markets at satisfactory prices while low quality trees were unsalable. Quality is the key to future markets.

What about competition from artificial trees? Trees manufactured from metals, plastics, and other materials are now on the market in direct competition to natural trees. Customers who have had low quality trees, or have difficulty in purchasing a fresh tree, may look to artificial ones as a substitute. Although artificial trees have captured only a small percentage of today's market, their increasing popularity has caused concern to many growers. This presents a real challenge for Christmas tree growers to improve quality and promote the fine qualities of natural evergreen Christmas trees.

What about competition in existing markets from other producing areas? Today about 30% of our production is used in Oregon and Washington and 70% is shipped to other states. More than 90% of our out-of-state shipments go to California. The Pacific Northwest's main competitors are Canada and Montana. Both areas produce good quality Douglas-fir almost all of which are uncultured, natural trees. However, Pacific Northwest trees generally have three definite advantages:

1. Closer to West Coast markets.

2. Brighter green color.

3. Stronger branch structure.

By concentrating on producing high quality trees, we should be able to more than hold our own against competition. Oregon and Washington have some of the best naturally suited areas in the world for growing Christmas trees.

IX. SUMMING UP

The success of a Christmas tree opera tion must be measured by net profits that the grower earns on his investme Profits can never be taken for grante even when trees are of high quality. Christmas trees are an unusual produc since they are both perishable and in short seasonal demand. This makes it especially important for growers to make sound harvesting and marketing plans well before the trees are cut. They must provide sufficient manageme manpower and equipment to meet a brie and busy harvesting schedule. Long hours of hard work, know-how and will ingness to take a financial risk are also necessary. Harvesting and marketing practices may make the diff ence between profit and loss to the grower.

X. SOURCES OF ASSISTANCE AND INFORMATION

Services of a farm forester are avail able to most woodland areas in Orego and Washington. The office address the local farm forester can be obtai by inquiring at any State Forestry De partment office in Oregon or State Department of Natural Resources offi in Washington.

Reference material is available from the County Extension Agent. He can also advise growers concerning the availability of assistance from farm foresters, extension foresters and others who work with Christmas tree growers.

Additional sources of harvesting and marketing information are:

Extension Forester, 206 Forestry Bld Oregon State University, Corvallis,

Extension Forester, Agricultural Extension Service, Western Washington Experiment Station, Puyallup, Wash.

Extension Forester, Agricultural Extension Service, Washington State University, Pullman, Washington.

(Continued next page)

ocal offices of the Soil Conserva-
ion Service.

. S. Forest Service, P.O. Box 3623,
ortland, Oregon 97208.

orthwest Christmas Tree Association.
The name and address of the current
ecretary may be obtained by contact-
ng a farm forester or the U.S. Forest
ervice at the above address.

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

IFIC NORTHWEST REGION-STATE AND PRIVATE FORESTRY

PORTLAND, OREGON

No. 8 Revised April 1971

CHRISTMAS TREE HARVESTING AND MARKETING FOR PACIFIC NORTHWEST GROWERS

'repared by Bernard S. Douglass, U.S. Forest ;ervice, Division of State and Private Forestry, n consultation with Gary H. Sander, Extension 'orestry Specialist, Oregon State University.
Guidance and assistance was also provided by he Oregon State Forestry Department; Washngton Department of Natural Resources; Oreon and Washington Extension Services; U.S. ;oil Conservation Service; Forestry School aculties of Oregon State University, Washingon State University, and the University of Vashington; and member growers of the N.W. 'hristmas Tree Association.

CONTENTS

FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

A. INTRODUCTION

Harvesting and marketing are of vital concern to the Christmas tree grower. For 7 to 12 years he has invested a considerable amount of money and many hours of hard work to grow and culture his trees. Yet the success or failure of his entire venture is determined by sales returns during a period of a few weeks. It is not surprising that successful marketing requires the same degree of skill, effort, and advance planning by the grower as is needed to culture a field of ungainly seedlings into high quality Christmas trees.

Christmas trees are unique as a commodity. For 11 months of the year they have little or no retail value. Then they suddenly become a valuable item of trade as some 45 million American buyers seek the tree of their choice. Just as suddenly, the Christmas season passes and cut trees become a liability, for it costs money to dispose of them.

The purpose of this bulletin is to provide guides which may be helpful to the grower during the brief, but important, harvesting and marketing period.

B. CONSUMER DEMANDS

1. **Quality Requirements.** Consumer studies have shown that the three most desirable characteristics of a Christmas tree are:

a. Adequate density of branches and needles.

b. Symmetrical cone shape.

c. Freshly cut appearance.

No amount of skilled merchandising will enable a seller to get top prices unless his trees are top quality. Some retail lots are overstocked with spindly, poorly shaped trees that should never have been cut. Unsold trees on Christmas Day are usually of low quality. Growers, wholesalers, and retailers who fail to set their sights on high quality will drop by the wayside as competition for markets becomes keener. In the long run it is the customer who sets the standards for quality. If given a choice, most customers will purchase a quality tree in preference to a cheaper one of lower grade.

2. **Principal Species.** The demand for the old standby, Douglas-fir, appears likely to re-

Table 1 — Christmas Tree Production in the Pacific Northwest*
1964 and 1969 Comparison

Species	Year	Oregon	Washington	Total	Percent
Douglas-fir	1964	410,000	2,360,000	2,770,000	88
	1969	525,000	1,890,000	2,415,000	83
Concolor and Grand Firs	1964	120,000	15,000	135,000	4
	1969	95,000	35,000	130,000	4
Noble, Silver, Shasta Red and Alpine Firs	1964	130,000	25,000	155,000	5
	1969	85,000	55,000	140,000	5
Scotch Pine	1964	5,000	20,000	25,000	1
	1969	45,000	120,000	165,000	6
All Other Species	1964	45,000	30,000	75,000	2
	1969	40,000	30,000	70,000	2
Totals	1964	710,000	2,450,000	3,160,000	100
	1969	790,000	2,130,000	2,920,000	100

*1964 and 1969 Special Forest Products Harvesting Reports for Oregon and Washington, U.S. Forest Service, Portland, Oregon. (Quantities rounded to nearest 5,000 trees.)

main firm for many years. However, it did drop from 88 to 83 percent of the total Oregon and Washington Christmas tree production between 1964 and 1969. During this 5-year period Scotch pine increased from less than 1 percent to 6 percent of total production, while noble and shasta firs (5 percent) and grand fir (2 percent) have held fairly steady. Production of concolor fir and lodgepole pine declined during this period.

Some species such as the spruces, Sierra redwood, cedars, cypresses, and pondorosa pine have never accounted for a very sizeable portion of Pacific Northwest Christmas tree production. Certain characteristics of these species and long established buying habits of customers make it doubtful that the demand for them will increase appreciably in the near future.

C. PREHARVEST CULTURAL WORK ON PLANTATIONS

1. **Basal Pruning.** Most plantations have already been basal pruned to form an adequate handle before the year of harvest. If this has been neglected, it should be done in the winter or early spring before the buds break dormancy. This permits time during the summer growing season for the branch scars to heal over. It also improves the appearance of the inside branches of the bottom whorl through response to sunlight exposure during the final growing season.

2. **Grass and Weed Control.** Removing the grass and weeds improves color and vigor by eliminating moisture competition and reducing shade around the bottom branches. Atrazine applied to the ground in February or March will eliminate most of the grass and weeds around the trees. In case of competition from braken fern, Canada thistle, orchard grass, and other atrazine-resistant plants, a narrow mower should be used.

3. **Fertilizing.** Most plantations with effective grass and weed control do not require fertilizing. However, where color or vigor is wanting due to competition of other vegetation or to nutritional deficiencies in the soil, fertilizing may be of great benefit. Nitrogen is most frequently the deficient element, and can be corrected by scattering 1/8 to 1/4 pound (actual nitrogen weight) of nitrogen fertilizers such as ammonium sulphate, ammonium nitrate, or urea under the drip line of each tree. Potash has also been used successfully to correct chlorotic decline resulting from low potassium levels in the soil. A good time to fertilize is March or April just before the buds begin to swell.

4. Shearing.

a. **Shearing Techniques Vary with Species.** Plantation-grown Douglas-fir require annual shearing with a shearing knife, hedge clippers, or power clippers to develop adequate density, cone-shape, and percent taper (width of the crown expressed as a percentage of its height).

Plantation-grown grand fir is frequently sheared annually, the same as for Douglas-fir, when excessively long internodal spaces develop between the whorls. However, noble, shasta red, and concolor firs respond best to light "fork shearing" – clipping off the tips of any individual branches that project beyond the desired cone shape. Although individual trees of the "true fir" species sometimes shape up naturally without any shearing, such spontaneous development is more frequently the exception than the rule.

Pines, unlike the firs, should have their annual shearing done only during their succulent stage of growth between about June 15 and July 15. Shearing during the dormant period will not result in an adequate bud set near the sheared tips.

b. **Finish Shearing.** "Finish shearing" is the final shearing before harvest. It should leave the tree in the best possible shape to market by:

(1) Developing a single, erect, well-balanced leader.

(2) Developing a uniform, cone-shaped crown.

(3) Minimizing visible stubs. Most trees that are ready for finish shearing spontaneously develop one or more erect leaders. A strong centrally-located leader is selected and cut back to proper proportion (usually 8 to 12 inches long). Competing multiple leaders are either cut back to proper proportion or severed where they join the main stem. Usual practice is to shear the leader and top whorl with a hand pruner as a separate operation to shearing the sides of the tree.

A proper cone shape is developed by shearing all sides of the crown uniformly between the tip of the sheared leader and the outer area of the bottom whorl.

A stub-free, natural look is attained by expanding the taper by about 10 percent (for example, from 50 to 60 percent) during the final shearing. This very light shearing cuts back only the longer branch tips projecting beyond the desired cone profile.

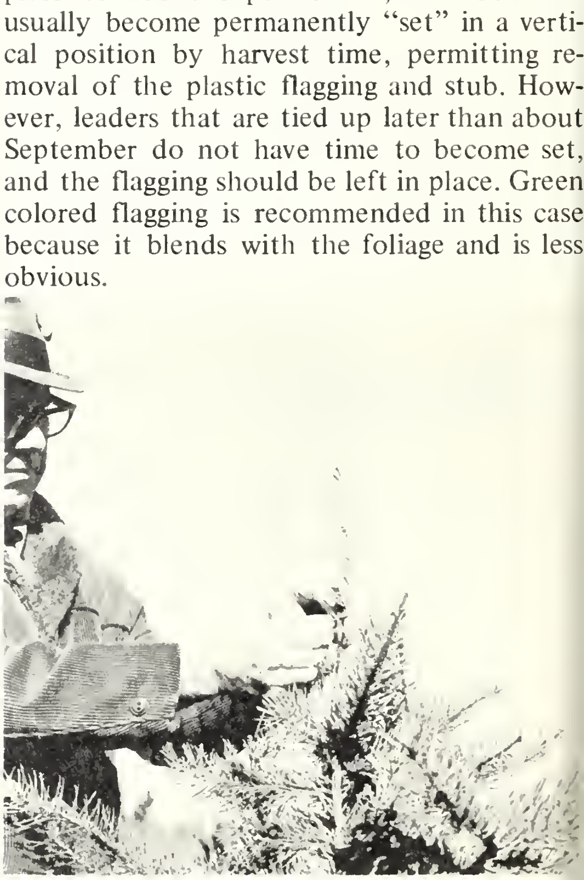
Finish shearing of the fir species can begin in July or early August when the new growth starts to harden off. Try to complete the shearing by November 1 to permit sufficient time for the cuts to weather over and lose their freshly-cut look.

Late summer regrowth called "lammas growth" sometimes occurs after a Douglas-fir has been sheared during early summer. A light touch-up shearing may be necessary in this event to restore good shape and proportion.

Finish shearing of all species should include removal of all unsightly in-pointing branches, visible suckers, dead branches, multiple leaders, and other growth that distracts from the quality of the trees. Some of these defects can be lopped off with the shearing knife or hedge shears, but a hand pruner gives better control over where the cuts are made and results in a more finished appearance.

This finish sheared shore pine is an example of the desired "natural look" – perfect symmetry, narrow cone-shape, lack of visible shearing stubs, and well-trimmed handle.

c. **Correcting Poor Leaders.** Where a single erect leader does not occur naturally, an artificial one can be formed as follows: Bend a flexible internodal branch to an upright position. Use several wraps of plastic flagging to bind its base snugly against a 2-inch-long vertical leader stub left for this purpose. When the new leader is tied upright prior to about September 1, its wood will usually become permanently "set" in a vertical position by harvest time, permitting removal of the plastic flagging and stub. However, leaders that are tied up later than about September do not have time to become set, and the flagging should be left in place. Green colored flagging is recommended in this case because it blends with the foliage and is less obvious.



Forming a single upright leader during finish shearing may make the difference between a saleable tree or a cull. This internodal branch is being trained to a vertical position by binding it against a short leader stub.

D. PREHARVEST CULTURAL WORK ON NATURAL STANDS

1. **Thinning.** Cultured natural trees do not develop properly if they are grown so closely together that their branches touch. Sufficient space should be allowed between branch tips for expansion of new growth during the next growing season. A good rule of thumb is to maintain an average spacing of about 5 feet between trees. However, somewhat closer spacing may be used where there is sufficient variation in heights to prevent crowding.

Thinning provides a good opportunity to select and save those trees with the highest Christmas tree potential. At the same time, remove all unwanted competition such as hardwoods, unadapted coniferous species, poorly developed stump cultures, oversized trees, crowded trees, and previously cultured trees that refuse to shape up properly.

2. **Basal Pruning**. Trees are basal pruned to form a good handle and expose the bottom whorl to sunlight. It is also a means of shocking *unsheared trees* to slow their growth rate. Trees are frequently basal pruned at the same time that they are thinned.

The selected bottom whorls of cultured natural trees should contain five or more well-spaced, vigorous branches in a main nodal whorl. One, and preferably more, additional growing seasons should be allowed between basal pruning and culturing to heal the scars and develop a bushy bottom whorl.

Bottom whorls of unsheared trees may be selected 5 feet or more above the ground. However, those of trees to be sheared should not be more than about 2 feet above the ground to keep the crowns within easy shearing reach.

3. **Fertilizing.** Nitrogen, such as urea or ammonium nitrate, is usually the most effective fertilizer to improve color, luster, branch stiffness, and growth rate of natural stands. Some stands produce additional response with fertilizers, such as ammonium sulphate, that combine sulfur with nitrogen.

Trees that will be ready to harvest after only one more growing season can be greened up by spreading 1/8 to 1/4 pound (actual nitrogen weight) under their drip lines. Trial and error is needed on each area to determine the least amount of nitrogen that will do the desired job of needle improvement. Most effective season of application is March or April just before the buds begin to swell.

4. **Shearing.** Shearing of natural trees to improve their density, symmetric cone shape, and percent taper is a growing trend for natural stands. Low site lands, such as the glacial tills in the Southern Puget Sound country, require nitrogen fertilizers to stimulate adequate growth response by sheared trees.

Light-sheared trees are described as having visible internodal spaces. Advantages over heavy-sheared trees are lower costs for shearing, harvesting and transportation. Also, they appeal to customers who prefer to decorate with pendulant-type ornaments. Lightly sheared trees can be produced in natural stands with only two or three consecutive annual shearings that remove the tips of the new lateral growth and, at the same time, cut the leaders back to 10 to 14 inches long.

Heavy-sheared trees are described as having denser crowns without visible internodal spaces. They are similar in appearance to plantation-grown trees. They are developed in natural stands by increasing the number of times sheared to four or five, and also reapplying fertilizer every 2 or 3 years to maintain a vigorous growth rate.

Finish shearing of natural stands is similar to that already described for plantations. It should be very light and create a near-perfect cone-shape. Best time for finish shearing is July and August, starting when the new growth begins to harden off. Quality can be improved by cutting back bracken fern, fireweed, and other summer vegetation at the time of shearing if it shades the bottom whorl.

All-weather access roads reduce yarding costs and save valuable time during the brief, but busy, harvesting season.

E. PREPARATION FOR THE HARVEST OPERATION

1. **Preparing Harvest Roads.** All harvest roads within and leading to the plantations or cultured natural areas should be surfaced with gravel or other all-weather surfacing material when clay or other muddy soil types would otherwise make them impassable during rainy periods.

Roads should be of adequate width to accommodate the largest truck or tractor-drawn wagon planned for the harvesting operations. Roads that need grading or surfacing should be worked in late spring or early summer to permit compaction of the road surface by summer vehicle traffic.

2. **Preparing Storage and Loading Areas.** Combining of the storage and loading area is recommended whenever possible to save moving the piles of trees twice. It should be located next to a road and as near to the cutting area as practical to minimize hauling distances. Storage capacity for at least one full truck load of trees is recommended.

A heavy grass, sawdust, bark mulch, or other protective cover on the storage area may be needed to protect the foliage from muddy conditions. Bare or sparsely vegetated ground can be sown in advance to rye grass or some other heavy cover crop.

Trees may be stored on both sides of the truck road on level ground. On steep ground, trees should be stored on the uphill side to make easier loading of trees into the truck bed.

The truck road to the loading area should provide sufficient curve radius and turn-around space to accommodate the largest sized truck that will be used for hauling. The best arrangement is an in-and-out loop road to the loading area so that trucks will not have to back up.

Surfacing should be extra wide and deep at the loading area to support the extra wear and tear on the road at this point and to prevent muddy conditions while loading.

3. **Inventory and Sales.**

a. **Preinventory Merchantable Trees.** Make a sample count of the approximate number of trees that will likely develop merchantable quality after being finish sheared. By doing this prior to about August 1, the grower will have an idea of the approximate number of saleable trees as a basis for negotiating early season sales.

b. **Complete Sales as Early as Possible.** Trees are sold earlier every year. Buyers are anxious to complete contracts to buy high quality trees in August or even earlier to beat their competitors. Since this is usually too early for making exact inventory of saleable trees, growers and buyers should allow some leeway in contracted counts to permit possible adjustments when the final fall inventory is made.

c. **Make the Final Inventory.** A complete inventory of merchantable trees by species, size, and sometimes grade should be made when shearing has been completed. This data may necessitate some adjustments in estimated quantities for sales contracted earlier in the year.

d. **Mark for Cutting.** Most growers prefer to make their own selection of trees to be harvested whether they do their own cutting, hire it done, or sell trees on the stumps. Trees are frequently marked for individual buyers by attaching a specific colored plastic ribbon to a branch or leader. White should normally be avoided because it will blend with snow. Another method of designating trees to be harvested is to defer shearing unmerchantable trees until after Christmas. However, sometimes the buyer and seller merely make a visual assessment of an entire stand of trees to be harvested, including a range of quality acceptable to both parties.

e. **Complete Sales.** Sale of all trees should be contracted by about October 1. Complete all selling arrangements before harvesting. (See Section G.5. for information on Christmas Tree Sales Contracts.)

4. **Lining Up Equipment and Men.** Chain saws, tractors and wagons, loaders, trucks, and other equipment are easier to contract, rent, or purchase well ahead of time than to wait until the last minute. Light weight chain saws are most popular for cutting trees. Consider a small crawler, rather than a wheel tractor, for mudding conditions where wheels might cause deep ruts. A large tractor-drawn rubber-tired hay wagon with high reinforced

end racks is the most popular vehicle for carrying trees between the field and the storage area. Mechanical hay bale elevators about 25 feet long are efficient for loading trees onto highway trucks at the storage area. The side racks on the elevators should be extended about 1 foot at a 45° angle. Tree hauling pickups or trucks should have high racks, open topped beds, and mud-tread tires.

Workers are needed to fell trees, yard them to the harvest roads, load and haul them from the field to the storage area, load them onto highway trucks and boxcars, and tally trees by species, height, and grade. One or two men might perform all these jobs on small operations. Necessary arrangements should be made for State Industrial Accident insurance and other payroll deductions. Accurate working time and payroll deduction records must be kept for each employee.

5. **Shipping Arrangements.** Make advance arrangements with the buyer as to the following:

a. Dates of shipment.

b. Truck or boxcar scheduling.

c. Tallying, height measuring, and tagging.

d. Responsibility for baling, if this is required.

e. Responsibility for loading.

f. Time and method of final payment.

6. **Trespass Protection.** Trespass may be a problem several months before Christmas. Signs and locked gates are recommended safeguards. More costly precautions such as special fencing or patrolling may be necessary in problem areas. Growers should obtain the cooperation of local law enforcement officers.

F. CUTTING, YARDING, AND HAULING TO STORAGE AREAS

1. **When to Harvest.** Time to harvest is largely determined by the shipping dates desired by the tree buyer. However, it may also be influenced by weather conditions, availability of men and equipment, and differences in durability of species. Noble fir, shasta red fir, Scotch pine, and Austrian pine, for example, are relatively good keepers because moisture from their needles transpires slowly. Under favorable storage conditions these species may be cut as early as mid-November without serious deterioration of freshness. On the other hand, plantation grown Douglas-fir, grand fir, and concolor fir are much more subject to water loss during storage. Prolonged storage may cause dehydration, shrinking, discoloring, and shedding of needles. Fresh-cut appearance is enhanced by *cutting the trees as late in the season as meeting delivery schedules will permit.* Quality-conscious retailers buying from local growers sometimes stipulate several cuttings and deliveries during their selling season to insure a constant supply of freshly-cut trees.

2. **Cutting.** Recent improvements in design and weight of chain saws have practically eliminated the use of hand saws in the harvesting of Christmas trees. Most popular chain saws are 6 to 10 pound types with about 16 inch bars. A "dog" attached to the end of the bar makes cutting and flipping the tops in the desired direction easier. Butts of plantation-grown trees should be sawn square and to proper handle length when the trees are felled. This will eliminate the need to retrim the handle as a separate operation. Flipping the falling trees with the bar to make the butts point toward the nearest harvest road will facilitate gathering the trees. Trees are usually designated for cutting by attaching a plastic ribbon or deferring the shearing of trees not ready to harvest until after Christmas.

Handles of cultured natural trees are normally cut a few inches over length if the trees are to be trucked to a concentration yard for sorting, baling, and handle trimming. This provides adequate trim allowance when the handles are resawn to proper lengths after baling.

When stump culturing is practiced in cultured natural stands, high stumps should be resawn closer to the ground as a part of the cutting operation. Stump heights of less than 2 feet are recommended if sufficient live branches remain on the stump to keep it alive and stimulate sprouting. High stump cultures place the crowns of the future trees above easy reach for top work and shearing.

3. **Yarding to Harvest Roads.** Trees should be removed from the field as soon as

possible after harvesting to prevent deterioration by drying winds, sunlight, and freezing followed by thawing. Temporary storage piles three or four trees deep along the harvest roads afford some protection against weather damage, and at the same time places them in a handy position to load.

Trees should be carried butt first to the nearest harvest road by holding one or two under each arm at their balance points. Dragging the tops on the ground should be avoided to prevent bruising and scraping off the needles. Trees should be piled evenly with their butts pointing toward the road. About 4 feet distance should be allowed between the butts and the tread to avoid running into them with vehicles and to provide the men adequate space to stand while loading.

4. **Hauling to the Storage Area**. Tractor-drawn hay wagons with high end racks are convenient for hauling trees from piles along the harvest roads to the storage and loading areas. A small crawler-type tractor is less damaging to soft or muddy roads than a wheel tractor. Pickups with high side racks or flatbed trucks with high end racks may also be used to haul trees out of the field; but only where the road bed is surfaced, built on gravelly soil, dry, or frozen solid.

Most efficient loading of hay wagons or flatbed trucks is accomplished by piling trees crosswise with the butts overhanging both sides of the bed about 6 inches. Ideally, the vehicle should be loaded from piles along both sides of the road. Trees may be loaded three or four trees high from the ground. Thereafter, a top loader is needed to receive trees boosted to him butt first by the ground loaders.

Unless the end racks of the wagon or flatbed truck are well braced, a "gut rope" should be stretched loosely between the tops of the end racks. When the trees are piled on top of the rope, their weight will draw the end racks together and help secure the load. Metal-braced, solid 5/8-inch plywood end racks are recommended for hay wagons. Open-frame end racks provide little protection from mud splattered by the tractor wheels or tracks.

The trees are unloaded and piled at the storage area, which usually serves also as a loading area for outgoing truck shipments. The storage piles should be kept shallow to prevent spoilage by heating. Butts of the stored trees should point toward the road with at least 4 feet of space between the road and the tree piles to facilitate loading and moving men and equipment on the loading area. Where it is necessary to pile the trees in several rows, the rows should be kept separated to prevent breaking and stripping of the leaders.

5. **Storage and Processing Prior to Shipment.**

a. **Protection from Spoilage**. Spoilage of trees stored for shipment can be reduced or eliminated by the following precautions:

(1) Keep piles shallow (only three or four trees deep) and separated to permit air circulation. This will reduce the chances of heating and mold.

(2) A good system for preventing crushing and heating damage to loose trees is to lean them against each other at an angle of about 30° from the vertical.

(3) Bare ground should be covered with branches, planer shavings, sawdust, or bark dust to keep mud off the trees and improve air circulation under them.

(4) Storing in a grove of evergreens will help keep the trees cool and reduce loss of water by transpiration during sunny or dry east wind periods.

(5) Covering exposed piles with loose branches or sprinkling will help conserve moisture during dry periods.

(6) Do not store trees in closed buildings.

b. **Baling**. Baling compacts the branches into a compressed bundle by slipping a hollow tube of plastic netting over the tree or making wraps of binder twine around the entire crown at close intervals. The main advantage of baling is to increase the number of trees that can be loaded on a truck or rail car. Additional advantages include reductions in handling costs and breakage.

Most sheared trees are heavy, stiff-limbed and bulky, and are baled singly. However, many out-of-state buyers and most local buyers do not require baling of sheared trees. Unsheared Douglas-fir, pines, and other limber-branched trees are usually bundled several trees per bale

when shipped to distant markets. Unsheared trees destined for local markets are sometimes left unbaled. The average number of trees per bale for various tree sizes is shown below.

Table 2

Tree Height in Feet	No. of Trees per Bale
2-3	8
3-4	6
5-6	4
7-8	3
9-10	2
11-12	1

Both hand baling and machine baling are utilized. Hand tying with twine is accomplished by placing the trees on a sawbuck type rack and tying a series of wraps, starting at the butts and working toward the tops. Twine treated with preservatives should never be used for baling, as it causes browning where it contacts the needles.

Balers make their jobs easier by suspending the trees between two sawhorses. Binder twine is used to tie the trees into compact bundles.

Hand baling with plastic netting is accomplished by pulling the trees through a funnel, and at the same time enveloping its crown in a sleeve of plastic netting drawn off a roll slipped over the neck of the funnel.

Plastic netting is well suited to bale heavy plantation grown trees singly.

Several types of machine balers have been developed for using both twine and plastic netting. Most machines are electric or gasoline powered and compact and tie the trees automatically.

c. **Tagging**. Some buyers require the trees be tagged to show species, height, and sometimes grade. The name of the buyer or his company is usually printed on the tag which is frequently a thin strip of heavy water-resistant paper suitable for stapling around a bottom branch. A different colored tag is frequently used to designate each tree height.

Heights and grades are usually determined on small operations by standing the tree against a calibrated pole. On larger operations, the trees are conveyed horizontally by endless belts on the grading table where they are measured and graded. The grader calls off the height and grade to a tagger who attaches the proper tag. Tagged trees are usually segregated by heights and grades to facilitate filling orders except where the buyer agrees to accept field-run trees.

6. **Loading Trucks and Railroad Cars**. The most common loading method for small trucks is by hand. Large trucks and trailers, too, are frequently loaded by hand where the total quantity of trees to be loaded, or economic circumstances of the shipper, does not justify purchase of a mechanical tree loader. However, a mechanical loader, such as a hay

bale elevator, is a real labor and time saver where a number of large trucks are to be loaded.

Hand loading involves one or two men called "top loaders" who receive the trees butt first as they are boosted or tossed to them from the roadside piles by an equal number of "bottom loaders." The size, stability, and compliance with legal dimensions of the load depends on the skill exercised by the top loaders in placing each tree properly and compacting it gently, but firmly, with their body weight. Pliable rubber boots are recommended foot wear for top loaders. They help prevent breaking and bruising of branches when the trees are walked upon and compressed.

An efficient method for loading pickups or small flatbed trucks with high side racks is described as follows: Place a layer of trees, butts forward, on the truck bed. Allow a space of about 4 inches between the sawn ends of the butts and the front rack behind the truck cab. This spacing prevents the butts from binding against the racks and hanging up when compression and weight causes the load to expand somewhat. Next, place a layer of trees with butts pointing the opposite direction and their sawn ends barely overhanging the leveled tailgate of the pickup or rear edge of the flatbed. Continue building up the load in this manner to the desired height, keeping the ends of the load square and filling in any cavities in the center of the load with shorter trees. Compress the trees as they are loaded by standing on their centers and rocking gently up and down. Place the last layer of trees with all their butts pointing forward to streamline the load and lessen wind resistance against the branches. The load should be bound down firmly with 1/4- or 3/8-inch rope placed over the top of the load at 3 or 4 foot intervals. The ropes will require tightening when the truck has been driven a mile or two.

Large 24- to 40-foot-long flatbed trucks and trailers may be hand or machine loaded in a somewhat similar manner to that of smaller trucks. One efficient method is to place all the trees butt forward except a single tier in the rear of the truck which is reversed to square up the end of the load. The butts should be held back of the endgate about 4 inches to facilitate closing it. The remaining trees, with butts pointing forward, should be staggered to fill in the spaces and lock the branches together to stabilize the load. Flatbed trucks frequently have 4-foot-high plywood side racks. Eight-foot-long, 2-by-4-inch studs are placed upright against the side racks at about 4-foot intervals to build up to maximum legal heights. Gut binders are strung between the 2 by 4's when the truck is half loaded to draw the sides of the load together.

Another truck loading method places the trees lengthwise, as described above, to a depth of about 4 feet. Then the load is finished by placing the balance of the trees crosswise with the butts facing outward. Two-by-fours are placed lengthwise on top of the load to provide an even distribution of pressure when the binders are tightened.

Handloading large trucks is difficult, especially where the trees are not loaded off a high bank. Sawhorses and planks are helpful on flat ground. A much quicker and easier loading method for both trucks and boxcars is with a power-driven hay bale elevator about 25 feet long. Trees are placed butt first on the conveyor, received on top of the load by one of the top loaders, and tossed over to the other top loaders who place and compress the trees.

Truck loading costs will vary with the size of tree, wage rates, and type of equipment; but average about 10 cents per tree for 6- to 7-foot sheared Douglas-fir.

Closed-top vans are much more difficult to load and have smaller carrying capacity than flatbeds with side racks and stakes. They are not recommended for hauling Christmas trees except in emergencies.

Railroads were at one time the main long distance carriers of Christmas trees. They have now been largely replaced by trucks, which have higher hauling rates but have advantages of speed, loading at the tree farm, and unloading at off-rail destinations. Trees stored for long periods in closed boxcars sometimes tend to overheat. This can be prevented by placing pallets on the floor of the box car, loading to form a center trough running lengthwise along the top of load, and top icing. Water from the melting ice flows through the load from the trough and draws away the heat produced by metabolism in the needles.

Mechanical tree loaders save time and money for quantity loading of trucks and boxcars.

Boxcars are most frequently loaded crosswise with the butts against the sides of the car and the tops overlapping in the center of the car. Average capacity of a 40-foot boxcar and a 40-foot flatbed truck with 8-foot-high stakes is about the same. Average truck and car capacities and weight per tree for various species and types of trees of 6- to 7-foot average height are shown below.

G. SELLING YOUR TREES

1. **To Whom to Sell.** The grower has three possible buyers for his trees:

   Wholesaler
   Retailer
   Consumer

He should realize that *each step nearer to selling directly to the consumer increases his opportunity for a greater profit, but at the same time increases his workload and risk of loss from unsold trees.* This explains why retail prices are usually at least double the wholesale prices paid to a grower.

A grower with several carloads or truckloads of trees to sell usually has insufficient time and facilities to make numerous small sales to retailers or to set up his own retail lot. His time is fully occupied by culturing, harvesting, and handling the trees; and profit depends on volume of sales rather than higher profit per tree. His best marketing arrangement may be to sell to an established wholesaler or large retailer.

A grower with only 500 or 1,000 trees to sell may have a different viewpoint. His workload is less, and he might be willing to take on the job of selling directly to small retailers – or perhaps even setting up his own retail lot if geography, finances, know-how, and personal inclinations point in this direction. By so doing, he may increase his net return per tree

Table 3

Type of Tree	Ave. Weight per Unit	Number of Trees or Bales per 40′ Rail Car or 40′ Flatbed Truck with 8′ Stakes
	Pounds	
Plantation Sheared Douglas-fir	30-40	700 – 800 trees
Natural Area Sheared Douglas-fir	20-30	1100 – 1300 trees
Unsheared Baled Douglas-fir – Regulars	30-40	750 – 850 bales
Unsheared Baled Douglas-fir – Premiums	55-75	550 – 650 bales
Plantation Sheared Scotch Pine	25-35	800 – 900 trees
Plantation Noble Fir	35-45	600 – 700 trees
Plantation Grand Fir	30-40	700 – 800 trees

considerably over wholesaling. But, again, it should be emphasized that every move closer to retailing increases the risk of unsold trees.

2. **Selling to a Wholesaler.** Established wholesalers are the main sales outlet for Pacific Northwest growers. They are able to handle large purchases of high quality trees. Most of them have a good reputation for paying promptly and fairly for the trees that they purchase. Wholesalers will normally accept delivery either at a truck-loading area at the tree farm or at a public rail-loading area, called a "team track."

Larger concentration yards, such as this one in western Washington, are highly mechanized. Each day thousands of trees are sorted by sizes, graded, tagged, baled, and placed on pallets in preparation for shipment.

Small operations, such as this one in eastern Oregon, need not depend on expensive equipment and a high degree of mechanization for tree processing.

Selling to a wholesaler at a concentration yard is common practice in the southwestern Puget Sound area. Here the trees are sorted by sizes and grades, baled, and prepared for shipment. Hauling trees to the yard is usually the responsibility of the grower who should check with the yard manager before any trees are cut to obtain specifications on species, sizes, grades, prices, and desired delivery dates.

3. **Selling to a Retailer.** Many growers find it more profitable and convenient to sell directly to a retailer, especially where their production is limited and their Christmas tree farm is conveniently located in relation to population centers. Retailers are looking for reliable sources of high-quality, freshly-cut trees. Once a grower has started to supply good quality trees to a reliable retailer, satisfactory selling arrangements may be continued year after year.

4. **Contacting Buyers.** A good source of names and addresses of retailers and wholesalers is the "Christmas Tree Directory of Oregon and Washington Growers, Wholesalers, and Retailers" which is published biennially by the U.S. Forest Service. Copies are available without cost from Farm Foresters and Extension Agents. A good way to obtain names and addresses of local retailers for future reference is to contact them at their place of business in December. Most Oregon and Washington growers and wholesalers, and many retailers, belong to the Northwest Christmas Tree Association. Meetings, field trips, and annual fall Christmas tree fairs provide excellent opportunities for prospective buyers and sellers to get acquainted and negotiate sales.

5. **Showing Your Trees to Prospective Buyers.** Growers should provide a clear and mutually understood description of quantities, heights, grades, and species of trees that are being offered for sale. By the same token prospective buyers should indicate exactly what type and quality of tree they are willing to accept at the negotiated price per foot or price per tree. A particularly important point for mutual understanding is the lower limits of acceptable grade or quality. Unless there is a complete meeting of minds on this, one or both parties to the sale will be dissatisfied and

unwilling to do future business with the other. Growers who include cull trees in their shipment, or substitute different sizes than those agreed upon, pay a high price in the long run through loss of their business integrity. Buyers who offer high stumpage rates but "high grade" only a small percentage of the merchantable trees, place themselves at a similar disadvantage for doing business in the future. A good procedure to avoid misunderstandings regarding tree quality is for the grower to invite the buyer to inspect and formally agree to acceptance of the cut trees before shipment.

Prospective buyers should always be shown the growing trees that are offered for sale. A good method for arriving at mutual understanding of which trees will be included in the sale is as follows: Designate several typical rows or areas of trees for all prospective buyers to look over. Invite each prospective buyer to attach a tag of colored plastic flagging to all trees that he is willing to accept in the sample rows or areas. Knowing both offered unit price and approximate number of acceptable trees, a grower can make a knowledgeable comparison of total financial returns from various offers. Also, he has a marking guide for future harvesting for any of the prospective buyers.

Other considerations besides tree selection and unit price should enter into deciding on the best offer. For example, consider the following questions:

a. Which party, the buyer or seller, is responsible for cutting and yarding to the truck loading area? Most growers prefer to handle this job themselves, rather than to have the buyer do it under a stumpage sale arrangement. An advantage to the grower in doing his own harvesting is that he can maintain close control over selection and tally of trees to be cut. Cutting and yarding usually costs about 25 cents per tree for sheared Douglas-fir.

b. Which party will do the work and pay for truck loading? This operation will cost about 10 cents per tree for sheared Douglas-fir.

c. Which party will do the work and pay for truck haul to a rail head, concentration yard, retail lot, or other destination?

d. Which party will do the work and pay for loading into rail cars?

e. Is the buyer likely to be a steady customer year after year or just a "one-shot" deal?

f. Does the buyer have a good business reputation?

g. Is the buyer a cash or credit customer?

h. Which buyer's desired cutting and delivery dates fit best into your overall harvesting schedule?

6. **Selling Contracts.** A signed agreement should always be made between the grower and the buyer at the time of sale. For better assurance that both parties fully understand the contractual requirements, the service of a qualified forester or an attorney is suggested. The sale agreement should clearly state the following conditions where they are applicable to the sale:

a. Quantity of trees by species, sheared or unsheared, size, and possibly grade.

b. Prices per tree or per lineal foot.

c. Handle length and handle trimming requirements.

d. Legal and local description of the tree farm.

e. Cutting, loading, and delivery dates.

f. Party responsible for doing the work and paying for cutting, yarding, baling, measuring, grading, tagging, storing, loading, and transportation.

g. Method and time of payment.

h. Provision for final inspection and acceptance of the trees prior to shipment.

i. Penalties or refunds in case of default of delivery for various causes or for order cancellations.

j. Any special requirements for stumpage sales, such as stump heights, protecting uncut trees, minimum sizes, right to use improvements, or repair of damage to improvements.

The most desirable selling arrangement requires that 50 percent of the total payment be made at the time of the sale agreement,

with the balance to be paid before trees are delivered or permitted to leave the truck loading area. This requirement will not discourage adequately financed buyers. It is *intended* to discourage last minute order cancellations, price downgrading, and poor credit risks. Shipping trees on consignment to any buyer is a risky business and is not recommended.

The grower is obligated to fulfill his part of the agreement, the same as the buyer. He can establish a good business reputation by keeping the trees in good condition and delivering on time.

7. Selling on Retail Lots. Here are some tips for the grower who is planning to set up his own retail lot:

a. The lot should be located in large population centers. Large cities or densely populated suburbs are best bets. The lot should be near heavily traveled main streets where the traffic flow is slow. Special attention should be given to availability of adequate parking facilities. Good prospects are supermarket parking lots, large shopping centers, and on vacant lots at important crossroads. Previous success or failure of other retailers in the same area will help the grower judge his own chances. Another important consideration is whether or not another retail lot already fully serves the neighborhood at your proposed lot. Existing competition, except along heavily traveled highway locations, could seriously impair the profit opportunities of both competitors.

b. The lot rental agreement should be completed in writing well before December. Advance arrangements should also be made for electric service, night lighting, house trailer, sanitary facilities, tree stands, sawdust walkways, signs, and displays. Most lots are opened the first or second week in December. All preparations and arrangements should be completed by this time.

c. Mounting the trees for display is a major problem, especially in windy locations. A good method on unsurfaced lots is to tie the handles of the trees to stakes driven into the ground about 5 to 7 feet apart. On hard or surfaced lots, the trees may be mounted on wooden frame racks, tied to a heavy wire stretched between poles, or mounted in individual concrete slab stands with a hole or taper pin through the center to hold the handle. Trees are held firmly in the slab by means of small wooden wedges, a threaded crank thru the side, or a taper hole in the handle. Lightweight stands are satisfactory only in protected or enclosed areas. The slightest wind will tip the trees over.

d. Trees are usually segregated by species and height classes. Many successful retailers keep a small number of choice trees prominently displayed as "eye catchers" to attract passing drivers or pedestrians. "High grading" can be controlled by setting a higher price for these choice trees than for average trees.

e. Trees from 5 to 7 feet in height will likely account for more than 80 percent of total sales. Taller trees from 8 to 12 feet in height are sold for larger homes or commercial outdoor displays. Trees less than 5 feet in height are in demand for trailer homes, table trees, or second trees for the children's room.

f. A variety of species from which to choose provides customer appeal. Douglas-fir is the best seller on most lots. Other good species to stock on a retail lot are noble fir, grand fir, Scotch pine, and shore pine. Production by species in Oregon and Washington is tabulated under Part B. 2., "Principal Species."

g. The retailer who grows his own trees is in a good position to offer and advertise freshly cut trees. This is a strong selling point with many buyers. Fresh trees can be kept in stock by cutting a new supply every day or two. This method of cutting has an additional advantage of keeping supply and demand in proper balance to prevent large numbers of unsold trees.

h. Protection of trees from drying and overheating is sometimes difficult on the lot. It is safer to store undisplayed or newly delivered trees in shallow piles in a cool shady spot and bring only small quantities at a time to the lot.

i. Retail prices vary a great deal depending on species, tree quality, lot location, and local competition. Average 1970 prices for a 6- to 7-foot U.S. No. 1 tree in metropolitan areas of western Oregon and Washington were approximately as follows:

Table 4

Species	Range	Average
Douglas-fir (sheared)	\$6.00–\$ 9.00	\$ 7.50
Douglas-fir (unsheared)	3.50– 5.50	4.50
Noble and Silver Fir	7.00– 13.00	10.00
Scotch and Shore Pine (sheared)	6.00– 10.00	8.00
Grand and Concolor Fir	6.00– 11.00	8.00

Low quality trees, by contrast, sold for as low as \$2 per 6-foot tree. Practically all lots cut prices a few days before Christmas to help liquidate surplus stock. An unsold surplus of 10 to 15 percent of total inventory is not unusual for most lots.

j. Loose boughs, especially noble fir, pine, and cedar are the most popular sideline item. Wreaths, door swags, mistletoe, cones, and tree stands are handled by some lots.

k. Some retailers find that including flocked trees will increase their profits. Flocked trees require protection from the weather but sale prices are about double those of natural trees. Favorite colors are white and pale blue.

l. Live trees in pots or wooden tubs comprise only a small part of total sales but are growing more popular. Favorite species are noble fir and shore pine. Price is about twice that of a cut tree.

m. Good sales records are essential for both cost accounting and estimation of next year's tree needs. Records should include species, heights, and cultural treatment.

n. The average customer is not an expert on tree species but he is very much aware of the quality. Some like to browse; others like to be helped with their selection. Christmas tree purchasers appreciate courtesy, sincerity, and wishes for a "Merry Christmas."

8. **Choose-and-Cut Sales.** Choose-and-cut Christmas tree farms offer special appeal to families who make cutting their own tree a traditional event. It also insures a freshly cut tree without having to trespass. From the grower's viewpoint, this method of marketing gives the best possible assurance of selling every tree that is cut. Prices are generally about the same as those on retail lots.

A horse-drawn hay wagon for hauling customers and their trees is a special attraction at this choose-and-cut Christmas tree farm.

Following are some tips for the grower who is thinking about setting up an operation in which the customer selects and cuts his own tree at the Christmas tree farm:

a. Location should be within about 40 miles driving distance from large population centers.

b. A variety of species should be grown to appeal to more customers.

c. Intensive advertising is especially important in the early stages of the business until steady customers are attracted. Posters and advertising in local papers, television, and radio are helpful. A feature story in a local newspaper is an effective means of publicity.

d. Large lettered signs with arrows pointing to the tree farm should be posted at road junctions. The landowner's permission should be obtained before the signs are posted. After Christmas, the signs can be taken down and stored.

e. Adequate parking space, turnouts, turnaround spots, and loop roads are necessary to relieve congestion. Roads and parking spaces should be gravelled and well-drained.

f. Good access trails should be provided in cultured, natural areas. Trails should ideally be located to form a loop pattern so that all trails lead back to the parking area. Trail signs with directional arrows are helpful.

g. A comfortable, well-heated shelter near the parking area is an asset for the comfort of the customers and for conducting business. Toilet facilities should be provided.

h. A customer going out to cut his tree should be provided with a handsaw. Information on available species, prices, and any special cutting requirements can be posted on prominently displayed signs or in leaflet handouts.

i. A customer returning to the shelter should check in his saw and pay for his tree. Services such as hot coffee, recorded Christmas carols, assistance in carrying the tree to the car, and binder twine to tie down trunk lids create goodwill at no great cost.

j. Other items such as boughs, wreaths, door swags, cones, and yule logs may be profitable sidelines. They should be prominently displayed.

H. CHRISTMAS TREE GRADES

The Agricultural Marketing Service of the U.S. Department of Agriculture has established three standard grades for Christmas trees: U.S. Premium, U.S. No. 1, and U.S. No. 2. Use of this system is optional. A bulletin, "U.S. Standards for Christmas Trees," and information on grading services can be obtained from offices of the Agricultural Marketing Service. Grade descriptions are summarized in Table 5.

Although not yet widely accepted by the industry, the U.S. Standard grades do establish a sound basis for determining quality and price. Several of the larger Christmas tree companies have been using their own grading system for many years. Industry-wide acceptance of a standard grading system would benefit both buyers and sellers by enabling them to talk in common terms when negotiating a sale.

Table 5 – U.S. Standards for Christmas Trees

	Required Standards for Grade				
Grade	Density	Taper	Balance	Foliage	Deformities
U.S. Premium	Medium	Normal 40-90% for pines 40-70% other species	4 faces free from damage	Fresh, clean healthy & well trimmed	Minor only
U.S. No. 1 or U.S. Choice	Medium	Normal	3 faces free from damage	Fresh, clean healthy & well trimmed	Minor only (noticeable deformation permitted if tree is otherwise U.S. Prem.)
U.S. No. 2 or U.S. Standard	Light	Normal flaring or candlestick	2 adjacent faces free from damage	Fresh, fairly clean, healthy & well trimmed	Minor only (noticeable deformities permitted if tree is otherwise U.S. No. 1)

DEFINITIONS:

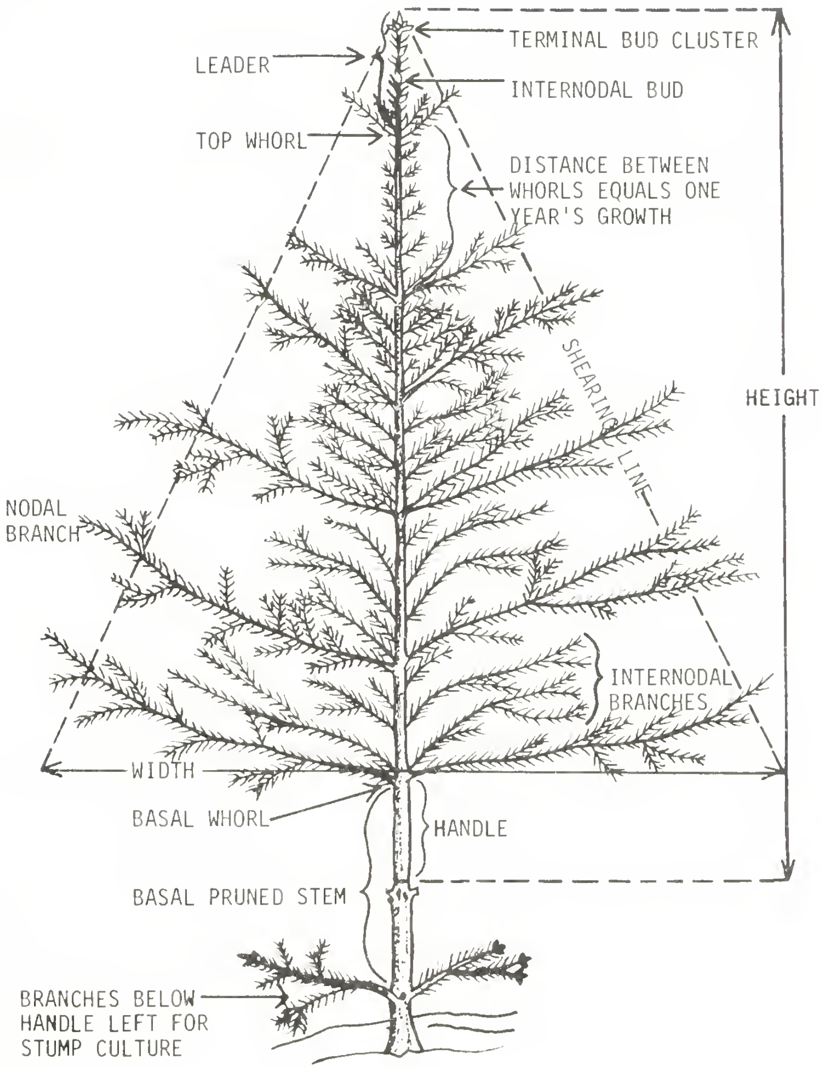
Taper: Relation of tree width to tree height, expressed as a percentage.

Tree Height: Distance from bottom of handle to top of leader, provided that handle is approximately 1 inch for each foot of tree height and leader length is proportional to overall tree height.

Face: The visible surface area of the tree viewed at a distance of 8 to 10 feet from the tree. A tree has four faces.

Damage: Any specific noticeable defect which distracts from the appearance or shipping quality. These include goosenecks, uneven density, broken branches, weak branches, barren lower whorls, curved stems, holes in foliage, excessively long leaders, incomplete whorls, handles not proportional to tree height, multiple leaders, dead twigs, loss of needles, abnormal appearing needles, and excessive moss, lichens, or other foreign material.

CHRISTMAS TREE TERMINOLOGY



I. LEGAL REQUIREMENTS

Legal requirements for harvesting, selling, and transporting Christmas trees in Oregon and Washington are summarized in Table 6. Applying for necessary permits well ahead of time will avoid costly delays or penalties during the brief and busy harvesting and selling season. More complete information and permit applications may be obtained by contacting the nearest office of the issuing agencies.

Table 6 — Legal Requirements for Harvesting, Selling, and Transporting Christmas Trees in Oregon and Washington

Requirement	When Required	Where Obtained
1. OREGON		
Permit to Harvest Miscellaneous Forest Tree Products	All commercial cutting	State Forestry Department
Either a Bill of Sale or Harvesting Permit	Transporting more than five trees	From Seller for Bill of Sale. From State Forestry Dept. for Harvesting Permit.
P.U.C. Permit	Over 6,000 lb. gross weight	P.U.C. Offices
Report of Christmas Trees Harvested	Cutting from all ad valorem-taxed private lands	County Tax Assessor
Permit to Harvest Forest Crops on Classified Reforestation Lands	Cutting from classified reforestation lands only	State Forestry Department Offices or State Department of Revenue
Retail License or Permit	Most cities	City Hall
2. WASHINGTON		
Specialized Forest Products Harvesting Permit	Cutting more than five trees	County Sheriff's Offices or Department of Natural Resources Offices
Yield Tax Permit and Yield Tax Report	Cutting from classified reforestation lands only	County Assessor
Annual Shipment Report	Out-of-state shipments only	Department of Natural Resources Offices
Either an Invoice, Bill of Lading, or Harvesting Permit	Transporting more than five trees	From Seller for Invoice. From Carrier for Bill of Lading. From Department of Natural Resources for Harvesting Permit.
U.T.C. Permit	Contract haulers only	U.T.C. Offices
Registration	All wholesalers and retailers	State Dept. of Revenue Offices
Retail License or Permit	Most cities	City Halls

J. A LOOK INTO THE FUTURE

Is there a danger of overproduction? Growers in the East are already facing this problem. Overproduction of quality trees has not yet become a problem in the Pacific Northwest. It may become one within the next decade because several times more trees are being planted each year for Christmas trees than future markets can absorb. However, in other areas of the country where overproduction has become a problem, growers of high quality trees have found markets at satisfactory prices while low quality trees were unsalable. Quality is the key to future markets in the Pacific Northwest.

What about competition from artificial trees? Trees manufactured from metals, plastics, and other materials are now on the market in direct competition to natural trees. Customers who have had low quality trees, or have difficulty in purchasing a fresh tree, may look to artificial ones as a substitute. Although artificial trees account for only about 15 percent of today's market, they are capturing an ever-increasing share, especially in Southwestern United States. This presents a real challenge for Christmas tree growers to improve quality and promote the fine qualities of natural evergreen Christmas trees.

What will be the impact of the sheared plantation-grown Douglas-fir? These trees are already having an impact. In 1959, they accounted for less than 1 percent of total Northwest production. Five years later sales increased to 5 percent. By 1970 they accounted for 25 percent of total Douglas-fir production, and still, production of sheared trees continues to increase. Unsheared Douglas-fir from natural stands have been the greatest casualties of this competition to date. Growers of cultured natural Douglas-fir in the southwestern Puget Sound country are beginning to develop a lightly sheared tree to compete with the heavier sheared plantation grown tree. Their lower production costs, lighter weights, good compaction during shipment, and somewhat open and natural appearing crowns are strong selling points. Only time will tell how well they are able to compete with plantation grown trees.

True fir and pine production is shifting from wild stands to plantations in ever-increasing numbers. Plantation management permits intensive cultural practices such as shearing, basal pruning, and fertilizing which tends to upgrade quality.

If quality is the key to *future markets,* genetics would have to be described as the key to *higher quality.* The present stage of genetic improvement is largely the identity and use of seeds from those strains, or geographic sources, that consistently produce better-than-average progeny. Most progress has been made with Douglas-fir and Scotch pine, but provenance tests are underway for the other principal species. The next step will be growing seedlings from elite genotypes within the better strains after progeny tests have determined that they are capable of passing desired inherited qualities to their offspring. Christmas tree growing from unselected field-run seeds should become obsolete within the next 10 years.

What about competition in existing markets from other producing areas? Today about one-third of our production is used in Oregon and Washington and two-thirds is shipped to other states. About 85 percent of our out-of-state shipments go to California. The Pacific Northwest's main competitors are British Columbia, Montana, and Michigan. The first two areas produce Douglas-fir, almost all of which are unsheared natural trees. The Michigan trees are sheared Scotch pine which compete in Southwestern markets. However, Pacific Northwest trees generally have five definite advantages:

1. Close to West Coast markets.
2. Responsive to shearing.
3. Short growing rotations.
4. Good color and freshness.
5. Strong branch structure.

By concentrating on producing high quality trees, we should be able to more than hold our own against competition. Oregon and Washington have some of the best naturally-suited areas in the world for growing Christmas trees.

K. SUMMING UP

The success of a Christmas tree operation must be measured by net profit that the grower earns on his investment. Profit can never be taken for granted even when trees are of high quality. Christmas trees are an unusual prod-

uct since they are both perishable and in short seasonal demand. This makes it especially important for growers to plan their finish shearing, harvesting, and marketing well before the trees are cut. They must provide sufficient management, manpower, and equipment to meet a brief and busy harvesting schedule. Long hours of hard work, knowhow, and willingness to take a financial risk are also necessary. Harvesting and marketing practices may make the difference between profit and loss to the grower.

L. SOURCES OF ASSISTANCE AND INFORMATION

Services of a farm forester are available to most woodland areas in Oregon and Washington. The office address of the local farm forester can be obtained by inquiring at any State Forestry Department Office in Oregon or State Department of Natural Resources Office in Washington.

Reference material is available from the County Extension Agent. He can also advise growers concerning the availability of assistance from farm foresters, extension foresters, and others who work with Christmas tree growers.

Additional sources of Christmas tree culturing information are:

Extension Forestry Specialist
Agricultural Cooperative Extension Service
117 Forest Research Laboratory
Oregon State University
Corvallis, Oregon 97331

Extension Forest Resources Specialist
Agricultural Cooperative Extension Service
Washington State University
317 Johnson Hall
Pullman, Washington 99163

Extension Forestry Specialist
Agricultural Cooperative Extension Service
Western Washington Research and
Extension Center
Puyallup, Washington 98371

Special Products Forester
Division of State and Private Forestry
U.S. Forest Service
Post Office Box 3623
Portland, Oregon 97208

Local offices of the Soil Conservation Service

The Northwest Christmas Tree Association provides meetings, field tours, culturing demonstrations, and current literature for its members. Most Oregon and Washington growers and wholesalers belong to this association. The name and address of the current secretary may be obtained by contacting any of the above-mentioned sources of information.

Both the Oregon State and Washington State University Extension Services provide biennial 2-day short courses for Christmas tree growers. Your local extension agent can provide information on time, place, and agenda of these training sessions.

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

PACIFIC NORTHWEST REGION STATE AND PRIVATE FORESTRY

No. 9 PORTLAND, OREGON February 1963

LOSSES OF TIMBER FROM FIRE, WINDSTORM, OR OTHER CASUALTY

If your timber was damaged or destroyed by fire, windstorm, ice damage, or flood, it is a casualty loss, and you may be entitled to claim a deduction on your income tax return. We have attempted to explain here the treatment of casualty losses as they may affect your federal income tax return.

Since timber is an asset, growing in volume as well as in value, the gain or loss incurred from ownership and management requires good records and careful analysis for income tax consideration. Income tax problems begin the day a timberland owner acquires his ownership. This discussion begins at that point.

This is not an official statement of the Internal Revenue Service, but has been reviewed for accuracy by one of their timber agents. This is a general statement to provide a broad understanding of the way to handle timber casualty losses for federal income tax purposes. Some details of the income tax law on casualty losses must be clarified by professionals in this field. Take your detailed problem to a revenue agent.

THE BASIS OF PROPERTY

To become oriented to the language of income tax law, it is first necessary to fully understand the meaning of the word "basis", as used therein. This word is repeatedly used in the Code and Regulations and will be repeatedly used in this discussion since it is a factor in the computation of realized gain or loss and taxable income.

As a general rule, the basis of property is its cost. The primary consideration in determining a casualty loss from a woodland, or a stand of trees, is the actual cost to the owner of the timber involved. The cost of the land must be kept separate from the cost of the timber or trees because the land cannot be depreciated or depleted for income tax purposes.

The basis of property includes not only the direct purchase price but also such indirect costs of acquisition as expenditures for title search, recording fees, brokers' commissions, or other costs of acquiring the property. In the event a tract of timber is purchased, for example, the basis may include such costs as amounts expended for the purchase cruise, running boundary lines, or initial appraisals, so long as they were incurred in the acquisition of the tract and were not previously used as income tax deductions. Annual property taxes on the tract can also be capitalized as part of the cost if not deducted annually.

FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

ALLOCATION OF COST OR BASIS

The acquisition of a timber property will often involve mixed assets such as land, buildings, and other improvements or subsurface rights, etc. The total cost of the entire property must be allocated among the several classes of assets involved to give each its own cost or basis for future calculation of gain or loss. Different classes of assets are given different tax treatment under the Internal Revenue Code. For example, the basis of timber is recoverable through depletion deductions while the basis of equipment is returned through allowances for depreciation. Land and certain other permanent assets are subject to neither depletion nor depreciation and their basis is recoverable only through sale or other disposition.

The general rule is that allocation of cost among the various assets is to be based upon the relative value of each asset to the value of the whole. As an example:

The cost of 100 acres of timberland containing 1 million bd.ft. of timber is	$12,000
Land value based on current sales or other facts	2,000
If no other assets are involved, value of timber is	$10,000

Reduced to a cost or basis per unit, it is $10 per thousand bd.ft.

If the tract contains stands of varying condition, separate allocations should be made to merchantable timber, submerchantable timber, and to reproduction. The allocations must be realistic to reflect relative values and kept in accounts that can be maintained with reasonable ease and accuracy as growth or depletion occurs.

Assume the basis in the timber were determined to be $10 per thousand bd.ft., as in the example. If a partial cut were to be made removing 40% of the volume and 70% of the value, according to the marking rule to be used, two timber accounts would be established. Forty percent of the total value would be allocated to the timber cut, while the remainder would be allocated to the residual timber account as follows:

	Quantity M Feet	Basis: Unit Rate (Per M)	Basis: Total Value
Timber to be cut	400 (40%)	$17.50	$7,000 (70%)
Residual	600 (60%)	5.00	3,000 (30%)
	1,000	10.00	10,000

This type of allocation requires establishment of a true and factual relationship between the values of the timber to be cut and the residual timber, and further demands that the marking rule be closely followed during the first cutting cycle. Any real deviation from the marking rule will, of course, tend to change the volume and the allocated costs of the timber in both accounts.

The value of bare timberland will vary with the general factors of location and accessibility, growing capacity, condition as to ground cover, and topography. Sales of bare timberland, as such, are not of frequent occurrence since it is seldom that timberland is entirely bare. More often, some other elements of value, such as roads or reproduction, are also present. However, adequate information can be developed to give reasonable indication as to bare land values which can be employed for the purpose of allocation.

When a portion of a timber stand is lost the deductible casualty loss is

the basis of each unit of timber multiplied by number of units destroyed. If, in a blowdown, the full basis of some of the down timber is recovered by salvage sale, those units would have no deductible casualty loss even if sold for less than full market value of the same timber standing. But the basis in the units of volume not saleable, because of breakage or other factors, is a deductible casualty loss.

TIMBER QUANTITY

Upon acquisition of a tract of timber, an estimate must be made of the number of units of timber known or believed to exist upon the tract as of that time. This estimate must state, as accurately as possible, the number of units of timber that the tract would produce upon the acquisition date if 100 percent of the merchantable timber were cut and utilized according to the prevailing standards of utilization. This estimate is normally expressed in terms of board measure, log scale. However, it may also be expressed in lineal feet of poles and piling or cords of pulpwood, depending upon the nature of the stand.

If at any time it should develop that there are more or less units of timber remaining in the tract than are reflected in the timber account, a corrective adjustment is immediately in order. The adjustment is made with the objective of restating the timber quantity in the account to reflect the corrected anticipated recovery. An adjustment of this type may result from such factors as growth, changes in standards of utilization, cruising error, or other reasons. The net effect of such corrective adjustments to timber quantity is a change in the unit basis or depletion rate, rather than an adjustment of the total cost.

Where applicable and practical, timber owners must maintain separate accounts for areas consisting primarily of trees of insufficient size to be currently merchantable. This is true whether the young growth occurs in separate and distinct areas or is intermingled with merchantable timber in an existing block. Logically, it would be unsound to include the basis of this submerchantable timber in a merchantable timber account, since such basis is recoverable only when this small timber reaches harvest size and is cut.

Quantities lost through casualty, such as fire, epidemic diseases and insects, or windthrow must be deducted from the timber account in the year of loss. However, such losses should only be deducted to the extent of actual loss after giving consideration to the quantity of timber subject to subsequent salvage. The mere fact that a quantity of timber was fire-killed or windthrown does not preclude the possibility of substantial recovery through early logging. Therefore, the amount of loss will be limited to the actual net loss in volume.

The deductible casualty loss is the basis in that net volume loss.

SUMMARY OF CASUALTY LOSS TREATMENT

You must have a basis in the timber lost before you have a deductible casualty loss when your forest stand is destroyed. This is determined by allocating the actual cost of acquisition between the timber and other kinds of assets included. The basis (cost) for each unit is found by dividing the net cost allocated to the stand of trees by the number of units in the stand. The deductible casualty loss for income tax purposes is the basis in the units of timber actually lost beyond subsequent salvage operations. A real loss of value is sustained when timber is destroyed but the amount of this loss over and above the net cost or basis in the units lost is not a deductible casualty loss.

OTHER TIMBER COST ACCOUNTING FOR INCOME TAX CONSIDERATIONS

By regulation, each taxpayer claiming, or expecting to claim, a deduction from income for depletion of timber must file a completed Form T (Timber) with his income tax return for the taxable year. This form is available from the Internal Revenue Service and is designed to assist the taxpayer in supplying information necessary for the audit of his timber accounts.

In general, the Code requires that costs which are capital in nature must be charged to a capital account while true current expenses must be deducted in the year incurred. However, the Code and the regulation also provide that, with respect to unimproved and unproductive real property, otherwise deductible carrying charges and development expenses may be capitalized at the election of the taxpayer. Included in the category of carrying charges are normal otherwise deductible current expenditures such as annual property taxes, interest on money borrowed to finance the purchase or interest on a mortgage, and expenditures made for fire protection. Development expenses are those incurred during the period in which portions of the tract are not producing net income but are being given silvicultural treatment for a future harvest. Development expenses may therefore include costs of girdling or poisoning weed species, fencing or pruning and thinning; but such expenses must be offset to the extent of any incidental income that is received from the operation.

The election to capitalize otherwise deductible carrying costs is applicable only to unimproved and unproductive real property so that upon becoming active from the standpoint of income production, a tract or account may no longer be given the optional treatment. Attention is also directed to the fact that while the regulation permits the capitalization of certain otherwise deductible costs, it does not permit the current deduction of expenditures that are purely capital in nature, such as reforestation costs.

Concerning the costs of reforestation, the regulation provides that amounts paid or incurred in connection with the planting of timber shall be capitalized and recovered through depletion allowances. This rule also applies to costs of planting for Christmas tree purposes. Examples of such expenditures are costs incurred in the preparation of the site for planting or for natural seeding and the cost of seedlings. The foregoing examples, as employed by the regulation, are broad, but the intent is deemed to be clear. Basically, costs incurred in the establishment of a new stand of timber are to be capitalized. However, costs incurred in the preservation and improvement of an established stand of reproduction, whether of natural or artificial origin, may be either expensed or capitalized at the election of the owner as development costs.

Once the young stand is established, the costs of preservation or improvement are considered to be deductible items, subject to the election cited above. Such costs would include noncommercial thinning, pruning, girdling, or cutting of weed trees, release operations, or other silvicultural practices that promote growth. But, any incidental income from such operations is an offset to the expense.

By regulation, all capitalized costs allocated or charged to immature timber are recoverable only through depletion, casualty loss, or through gainful disposal.

CAPITAL GAINS TREATMENT

Under certain conditions income from the sale of timber or timber lands is subject to the capital gains provisions of the Internal Revenue Code of 1954 Sections 1.631a; 1.631b. Details of this are found in income tax Form T (Timber) available from the Internal Revenue Service. If income from timber qualifies, the income tax paid may be reduced considerably. It will pay you to check this.

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

PACIFIC NORTHWEST REGION—STATE AND PRIVATE FORESTRY

No. 10 PORTLAND, OREGON June 1963

BLOWDOWN PROBLEMS AND SOLUTIONS

INTRODUCTION

The 1962 Columbus Day windstorm and other winter storms created problems for many forest owners. Windstorms are, of course, recurrent and some owners face this problem each year. This year, more timber is down and more woodland owners suffered losses than ever before. This bulletin describes some of the blowdown problems facing the woodland owner and suggests some solutions.

When trees blow down no set pattern is established. Large blocks of timber may blow over or scattered trees may be upset. Breakage may ruin many logs. A fire hazard is created. A breeding ground for insects is provided, and they may cause future damage worse than the wind effect. Down logs will rot--some faster than others. These, and other factors, influence what a landowner should do with his blowdown area.

FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

MARKETING AND UTILIZING BLOWDOWN

A. Blowdown Should Be Salvaged Quickly.

The greatest returns from blowdown timber can be realized by salvaging it as quickly as possible. Owners who delay logging in hopes of getting higher stumpage or log prices risk losses from fire, insects, and decay. Resulting losses would probably offset any possible log price increases that might be gained by waiting.

B. Owners Should Not Expect Green Timber Stumpage Prices for Their Blowdown.

Loggers have found that it frequently costs 25% to 50% more to log blowdown than green trees. Falling and bucking is difficult, breaks and splits must be bucked out (Fig. 1), trees are scattered, and special care must be taken to protect green standing trees. Owners should, therefore, expect stumpage offers that are several dollars less per thousand board feet than would be offered for undamaged timber.

FIG. 1

BREAKAGE INCREASES LOGGING COSTS AND DECREASES LOG VALUES. THE MOST VALUABLE LOG ON THIS TREE HAS BEEN SHATTERED AND RUINED.

C. Determine the Most Profitable Markets for Blowdown.

Farm Foresters and County Extension Agents can provide advice on log markets and current prices. The market for pulpwood, poles, posts, and cordwood should also be explored. Some mills place length and diameter limits on logs. This makes logging more difficult or results in wasting small-sized logs. A clear understanding of acceptable log lengths and diameters should be reached in advance with the log buyer.

D. Other Considerations.

1. Woodland owners are sometimes tempted to clear-cut immature timber stands that contain light to moderate amounts of blowdown. This can be a costly decision to the owner when sufficient healthy standing trees remain to provide good future growth. The local Farm Forester should be consulted when it is questionable whether to clear-cut or salvage only the blowdown.

2. Agreements on stumpage sales and contract jobs should be in writing. A publication "Timber Sale Agreement Guides for the Woodland Manager" is available from Farm Foresters, County Agents, or the U.S. Forest Service, Division of State and Private Forestry, P.O. Box 3623, Portland 8, Oregon.

3. Investigate possibility of selling scattered blowdown to loggers with self-loading trucks.

4. Investigate possibility of selling small logs to a portable mill-owner or contracting with him to custom-saw lumber for your own use. A list of portable sawmills is available from your Farm Forester.

5. Consider doing your own logging if you have the experience and equipment (Fig. 2).

6. Salvage scattered or small blowdown material for firewood, fencing, and construction use.

7. Complete all Columbus Day blowdown removal and cleanup by May 1964.

FIG. 2

WOODLAND OWNER SALVAGING BLOWDOWN WITH LIGHT EQUIPMENT.

FIRE HAZARD AND PROTECTION

The most obvious and immediate problem is the fire hazard. Large amounts of fuel exist from down trees and branches snapped off by the wind. This fuel will be dry and flammable by July or August. The potential for fires to get large and dangerous is present. Stopping a fire in blowdown is difficult. Fire prevention is, as always, the best measure.

A. Prevention.

Campaigns by forest protection organizations for fire prevention will be in full swing during fire season. The landowner can help by cooperating with the local Fire Wardens and by doing some of the following:

1. Signing - Signs, such as those pictured here (Fig. 3), are effective in pointing out danger areas. Post on roads, trails, fence lines, and other strategic places near blowdown areas.

Keep Green Associations or your local Fire Warden have these signs available without charge.

FIG. 3

SIGNS CAN BE USED TO POINT OUT FIRE DANGER IN BLOWDOWN AREAS.

2. Precautions - Strict observance of State fire regulations while operating in the blowdown area is necessary. Fires which may spread to the blowdown area from adjacent fields or other areas must also be prevented.

B. Fire Trailing.

Hazardous areas should be surrounded by fire trails. By construction of such fire control lines and providing access for men and machinery, quicker control of any fire may be expected. Development of fire trails before logging is recommended.

Fire trails should be at least the width of a dozer blade and cleared to mineral soil. On steep ground where tractors cannot operate, a hand trail 3 feet wide is desirable.

Taking advantage of natural openings, roads, rock areas, and logging skid trails can reduce the amount of construction.

Roads should be kept open (Fig. 4). Logs must be bucked out and stream crossings and drainages kept passable. Fire equipment must be able to get to the area.

FIG. 4

OPEN ALL ROADS INTO HAZARDOUS AREAS.

C. Burning.

Logging and blowdown slash should be disposed of by burning, preferably in the spring or fall. A permit is required during the fire season and may be obtained from the local Fire Warden or Rural Fire District Chief. Burning may be done in two ways--piling and burning or broadcast burning. Where green trees remain in an area, slash piling is necessary. A waterproof cover over the center of the pile will keep it dry for wet weather burning. Broadcast burning disposes of the slash where it lies. Adequate firelines are necessary.

If slash disposal over the entire area is not possible or must be delayed, consider fireproofing a strip on each side of the roads in the area. This will give some measure of protection.

Burning plans should be discussed with the local Warden. He will provide advice and at times is available to lend assistance. He will require adequate tools and other precautions.

BEETLES AND DAMAGE

Beetles occur in all sizes, shapes, and colors. Many of them eat wood. Beetles can kill green trees or ruin blowdown logs. They are something to be concerned about.

A. Bark Beetles.

Recently felled or blowdown Douglas-fir logs are almost always invaded by the Douglas-fir beetle. This beetle does not penetrate into the wood but lives and reproduces just beneath the bark. The emerging beetles, if present in sufficient numbers, will attack and kill green trees.

1. Damage - Bark beetles may build up in such large numbers that they will kill many green trees. The period after a major blowdown is especially bad since down logs are available as breeding places. A season later, the beetles emerge and attack green trees adjacent or some distance away. Beetle-infested logs are also more susceptible to rot and stain damage.

2. Life Cycle - The adult female beetle (Fig. 5) bores through the bark and excavates a tunnel $\frac{1}{4}$ inch wide and up to 30 inches long between the wood and bark.

Eggs are laid alternately in groups along the sides of this tunnel. These eggs hatch and the larvae eat out at right angles to the main gallery. The larvae then form pupae and after a period of time develop into adult beetles. The adult beetle normally emerges in the spring to repeat this life cycle in recently felled logs, windthrown timber, or weakened trees.

FIG. 5

MAGNIFIED DOUGLAS-FIR BARK BEETLE. ACTUAL LENGTH OF THIS BEETLE IS 1/8 INCH.

3. How to Recognize - First evidence of Douglas-fir bark beetle attack is the reddish boring dust. Little piles of this dust are seen in bark crevices on down logs. By chopping off a piece of bark, the distinctive bark beetle egg gallery may be seen (Fig. 6).

When green trees are invaded, the first sign of attack is fading of the needles. When the needles turn red the tree is already dead. Trees are usually killed in small groups.

FIG. 6

DOUGLAS-FIR BEETLES BURROW EGG GALLERIES BETWEEN THE BARK AND THE WOOD. EGGS ARE DEPOSITED AND HATCH INTO LARVAE WHICH BURROW AT RIGHT ANGLES MAKING THIS TYPICAL PATTERN.

4. Control - The only economical control method is salvage logging of infested trees and windfalls. Chemical sprays are costly and impractical.

Blowdown trees from the Columbus Day storm must be out of the woods prior to May 1964 to help prevent additional damage. All timber owners should attempt to meet this goal. Bark beetles will emerge from blowdown logs and attack green trees next spring. They pay no attention to boundary lines. Your neighbor's beetles may attack your trees. Standing trees killed by beetles should also be salvaged as soon as possible.

B. Other Beetles.

Other beetles, such as wood borers and ambrosia beetles, may also cause considerable damage. These beetles generally attack only the dead trees or down logs. Their borings may cull or degrade logs and cause great losses in value.

1. Ambrosia Beetles - These small beetles select dying and freshly felled trees, or unseasoned, moist wood for attack. Small round tunnels are bored directly into the sapwood and heartwood. A fine, light-colored powder comes from these borings.

The holes, surrounded with a dark stain, are a serious defect in lumber (Fig. 7).

Control is largely a matter of prevention. Blowdown or freshly cut timber should be logged without delay. Logs should be promptly sawn, or stored in water. Green lumber should be piled so it will dry rapidly.

2. Wood Borers - There are many types of wood boring beetles. They vary in size and shape and may cause extensive damage to dead timber (Fig. 8). Trees that might be sold as poles are often ruined for this purpose by wood borers. Borer damage consisting of pencil-size holes can be expected in blowdown.

Early logging and water storage are advised to reduce borer damage.

FIG. 7

TYPICAL "SHOT HOLES" MADE BY THE AMBROSIA BEETLE. THIS BEETLE ATTACKS DEAD TREES AND LOGS.

FIG. 8

MAGNIFIED LARVA OF THE WOOD BORER. ACTUAL LENGTH IS ABOUT 1 INCH.

LOG DETERIORATION

Resistance to decay varies with tree species. However, other factors also affect the rate of decay. For example, little decay occurs during cold winter weather but warm spring and summer temperatures stimulate the development of wood-staining and wood-decaying fungi. Uprooted trees will remain green and decay-resistant longer than broken-off trees. Bark beetles and other boring insects increase the chance of early decay by carrying fungi spores into the wood.

The sooner blowdown is salvaged the less chance there will be for decay loss. Early salvaging is particularly urgent for less decay resistant species such as alder and hemlock.

A. Rate of Decay in Hardwoods.

Hardwoods, such as alder, maple, and cottonwood decay rapidly. They should be salvaged before the end of the first summer.

B. Rate of Decay of Conifers.

1. Sapwood - In all coniferous species, sapwood is much more susceptible to decay and stain than heartwood (Fig. 9). Stain and early stages of sapwood decay may occur by the end of the first summer after blowdown. By the end of the second summer, sapwood may be too decayed to make lumber. Since small trees contain a higher ratio of sapwood than large trees, they should be salvaged as quickly as possible. Most log buyers are reluctant to purchase small logs with decayed sapwood.

FIG. 9

DOUGLAS-FIR SAPWOOD USUALLY STARTS TO DECAY DURING THE SECOND YEAR AFTER BLOWDOWN.

2. Heartwood - The decay-resistance of coniferous heartwood varies greatly between species. The age of the tree also has an influence. Large diameter Douglas-fir may have sound heartwood for many years after the sapwood decays. Heartwood of small Douglas-fir will usually start to deteriorate in about four years (Fig. 10). The less durable heartwood of hemlock, grand fir, and white fir usually starts to decay in two or three years. Comparative decay rates for heartwood of coniferous species are shown below, with the least resistant species listed first:

Hemlock
Grand and white firs
Spruce
Second-growth Douglas-fir
Pines
Old-growth Douglas-fir
Cedar

FIG. 10

DOUGLAS-FIR HEARTWOOD IS MORE DURABLE THAN THE SAPWOOD. IT WILL ORDINARILY RESIST DECAY UNTIL THE FOURTH YEAR.

C. Decay in Wind-Damaged Standing Timber.

Windstorm damage may have a serious delayed-action effect on the trees. Many trees will eventually start to decay where the wood is exposed. Trees with broken tops, large broken limbs, and bark scraped off by falling trees are particularly susceptible. Leaning trees may have their root systems weakened so they will topple over during future windstorms. Whether these trees should be salvaged with the blowdown or cut at some future date depends on current log markets and the circumstances of the owner. If, for example, a forest owner has a large volume of blowdown, he may wish to defer the logging of damaged green trees until he completes the blowdown salvage. In other cases, he may find it more economical to log damaged green trees along with the salvage. It is a good idea to consult your Farm Forester for assistance before deciding which trees to cut.

D. Storage of Logs to Prevent Deterioration.

Log markets may be temporarily lacking due to local over-supplies of blowdown timber. The owner might find it necessary to protect his logs from deterioration until he can make satisfactory selling arrangements or have them custom sawn for home use. Logs deteriorate in two ways: decay and checks. Both can be controlled by storing the logs in water. Farm ponds, sloughs, and abandoned mill ponds offer possibilities (Fig. 11). Where ponds are not available, the logs can be preserved by use of a sprinkler system over the decked logs. The sprinkler must be operated continously and give complete water coverage. Intermittent wetting and drying of logs should be avoided because it makes conditions most favorable for decay and checking.

FIG. 11

MARKET CONDITIONS MAY FORCE TEMPORARY LOG STORAGE. POND STORAGE OF LOGS PREVENTS DECAY AND INSECT DAMAGE.

TAX CONSIDERATIONS IN BLOWDOWN LOSS

Losses of timber due to windstorm, fire, or other disaster may be a tax deductible item. However, to qualify, the owner must have actual capital investment in the timber.

This subject is more fully covered in Managing Your Woodland, How to Do It Guide #9 entitled "Losses of Timber from Fire, Windstorm, or Other Casualty". This pamphlet may be obtained from the Farm Forester or County Extension Agent.

TYPES OF ASSISTANCE

A. Farm Foresters.

Farm Foresters, employed by the State Forester in a cooperative program with the U.S. Forest Service, provide technical assistance to woodland owners without charge. With headquarters in most counties, they provide advice regarding management problems, such as debris cleanup, thinning, harvesting, marketing, and protection measures.

B. Emergency Assistance. (ACP F-4 Practice)

Special Agricultural Conservation Program (ACP) emergency funds are provided for a limited period. Landowners in counties designated as disaster areas because of the 1962 Columbus Day storm are eligible. Under this program a part of the cost of cleaning up storm-caused debris from woodlands and stream beds is reimbursed to the owner. Application is made at the county ASCS office. Eligibility for cost-sharing is determined by the Farm Forester.

C. Reforestation.

The regular Agricultural Conservation Program of the Agricultural Conservation and Stablization Service offers cost-sharing for replanting forest lands. This is also handled by the ASCS office and the Farm Forester in your county. Planting stock may be purchased from the State Forester. Farm Foresters and County Agents can provide further information and order blanks.

D. Loans Available to Woodland Owners.

1. Federal Land Bank - Loans can be made using merchantable volume in the woodland as security. Such loans are currently made at 5½% interest. The money can be used for any purpose.

2. Farmers Home Administration (FHA)

FHA loans can be made for specific purposes such as blowdown cleanup, reforestation, thinning, acquisition, etc. Basic requirements are:

a. Borrower must show that he cannot secure an adequate loan from another source.

b. Borrower must prove ability to repay the loan from the products of the land.

FHA loans can be made for some forestry purposes at an interest rate of 3%. Further details can be secured from the Farmers Home Administration office in your county.

MANAGING YOUR WOODLAND

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PORTLAND, OREGON

No. 11 June 1965

REFORESTING CUTOVER WOODLAND IN THE PACIFIC NORTHWEST

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FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

INTRODUCTION

The establishment of trees is one of the first steps in managing a forest. Much of the woodland in the small ownership class (less than 5,000 acres) is considered either nonstocked or poorly stocked. Also, a substantial area of private woodland is logged each year and prompt reforestation will insure a new crop in the shortest possible time. How economically the owner does the job will determine, to a great extent, his success as a woodland manager.

Many small woodland owners are not aware of the technical difficulties that will be encountered during a reforestation program. Numerous publications available contain information about reforestation. The aim of this "Reforestation Guide" is to combine under one cover the information needed by the small landowner who wants to establish trees on forest land.

Lands needing reforestation can be grouped into three classes, namely: (a) marginal agricultural, (b) recent cutover, (c) older cutover poorly stocked.

Considerable agricultural land has been forested since 1958, stimulated largely by the Soil Bank Program. Some specific and unusual problems developed when old hay and grain fields were planted. To answer these problems, we recommend special report 139, "Planting Forest Trees on Old Fields", Carl Hawkes and Benjamin Mason. This "How to Do It" will not be concerned with old field planting.

THE LANDOWNER'S PROGRAM

Before a landowner starts a reforestation program he should ask himself several questions:

1. What will be the final forest product?
2. What species of trees should be grown?
3. What is my plan for accomplishing the job?
    a. Should I seed or plant?
    b. Do I need site preparation, brush control, rodent control, or any other kind of work?
    c. What methods do I use to do the job?
4. Where do I get trees or other material needed?

The Landowner's Problem

What Species?

Site Preparation?
Burn?
Pile Brush?
Scarify?
Spray?

Plant?	*Seed?*
Size?	*Direct?*
How?	*Broadcast?*
Hand?	*Hand?*
Machine?	*Aerial?*
Auger?	

Animal Control?

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
PACIFIC NORTHWEST REGION
POST OFFICE BOX 3623
PORTLAND, OREGON 97208

IN REPLY REFER TO

1630

July 6, 1965

We are sending you a copy (or copies) of Managing Your Woodland - How to Do it Guide No. 11, "Reforesting Cutover Woodland in the Pacific Northwest".

This is a new addition to the Managing Your Woodland series. It was prepared to help the new or inexperienced woodland owner in the Pacific Northwest with his reforestation problems. We hope this will be a useful publication and will welcome comments for improvement of future revisions.

Additional copies are available from the Division of State and Private Forestry.

Sincerely yours,

E. H. Marshall

E. H. MARSHALL
Assistant Regional Forester

he Final Product

ne forest can have several uses and roduce several kinds of products be-ore the final harvest. However, the rivate landowner will generally have o decide on the most profitable land se. This might be growing timber, hristmas trees or use as a recre-tion area. Even though timber is he final product, material such as ulpwood, posts, or poles can be arvested prior to the final cut. lso, many forms of recreation use re compatible with growing forest roducts when harvesting methods are odified to fit the other use. For ne purpose of this guide we will ssume that timber is to be the inal product.

he Species of Trees

xperience and studies show that the ative trees of the Pacific Northwest re superior to introduced species or most uses. The best guide to ollow is to consider what originally rew in the area. East of the ascade Mountains it will often be onderosa pine. West of the Cascades t will often be Douglas-fir. Along e Coast, Sitka spruce and western mlock can be mixed with the ouglas-fir. Other species are also ailable for various purposes.

 native tree species are used, the ndowner should match the seed source s close to the planting or seeding te as possible. The source should within the same 1,000 foot eleva-on range. It should also have a milar geographic location. Seed alers and tree nurseries keep cords of the seed origin so that e landowner can obtain suitable ed or seedlings.

he Plan for Accomplishment

efore the landowner can make a refor-estation plan he must have some basic iformation about his land.

Much of this can be obtained while making a stocking survey. This is done by simply walking through the area or by using a formal systematic method. No matter what system is used the following things should be determined.

1. Number of natural seedlings per acre.
2. Areas overstocked or under-stocked.
3. Areas where brush suppresses seedlings.
4. Areas of intensive rodent or other wildlife population and uses.
5. Areas unsuitable for trees; such as rock outcroppings, swamps, etc. A map showing these areas is helpful when determining acres needing treatment.

A small amount of time spent in mak-ing this simple examination will enable the landowner to plan a more economical and practical reforestation job.

Here is simple procedure to use in making a formal stocking survey.

Use 1/250-acre circular plots. These have a radius of 7.45 feet.

Follow a compass line across the area. Travel in a cardinal direction if possible. This reduces chances for error in direction and makes mapping easier.

Lines should be 5 chains (330 feet) apart. Plots should be 1/2 or 1 chain apart on the lines. This depends on size of the area. For areas less than 40 acres the 1/2-chain interval is recommended. Number plots consecu-tively. These can be plotted on a simple map and will show problem areas, etc.

Tally the stocking on each plot as follows:

S - Satisfactory, one or two seedlings or saplings.

O - Unstocked, no trees.

+ - Overstocked, more than 2 trees per plot.

U - Unsatisfactorily stocked, trees present but unable to grow because of brush suppression, animal damage or other factors.

Also tally other items, including area plantable, area not plantable, needing brush control, animal damage (what kind), heavy slash, and areas needing pest control.

Once a landowner has inventoried and mapped his area he can make a practical plan. The plan might include the following items:

A. Areas adequately stocked.

1. Release needed, chemical or mechanical.

2. Precommercial thinning needed.

B. Areas inadequately or unstocked.

1. Site preparation needed, chemical or mechanical.

2. Areas suitable for seeding. Northerly aspects. Scarification needed.

3. Areas to be planted. Spacing, species, age class of seedlings, planting method.

4. Areas unsuited for trees, bogs, rock outcroppings.

5. Wildlife Control needed.

A landowner may not encounter all the problems or conditions that have been mentioned. He should, however, be on the lookout for them.

TO SEED OR PLANT?

This is a major decision for the landowner. Some basic principles must be considered in order to develop a sound answer. Seeding is usually the most economical method when conditions are favorable. Determining the suitability of these conditions includes considering such items as: Aspect, topography, ground conditions, soil types, animal population and availability of seed.

Two Reforestation Methods

Loading a Helicopter with Tree Seed

Planting 3-year-old Douglas-fir with a Planting Hoe

pect. This is the direction that slope faces and is directly related exposure to the sun. Slopes with rth, northeast or northwest aspects e much more favorable for seeding an south, southeast or west aspects.

pography. Steepness of slope generly does not prevent successful seedg. In fact, seeding is less costly an planting steep rocky slopes when her conditions such as aspect are vorable.

ound conditions. Tree seeds, espeally Douglas-fir and ponderosa pine, quire a mineral soil seedbed for best rmination and growth. This has been monstrated by numerous research udies. Logging usually causes ough soil disturbance to create equate seedbeds. Because of this, ospects for seeding recently logged eas are often good.

l types. Most forest soils will fertile enough to support tree owth. Some types, such as deep ice, are subject to severe drought. order to obtain satisfactory stock- it may be necessary to use ecial planting stock and methods or ter required treatment.

imal populations. Excessively large ubers of animals that eat seeds or edlings must generally be controlled ist to insure satisfactory stocking.

ailability of seed. Seeding can be ne by natural or artificial means. aural seeding can be done only durng good seed years with an adjacent ed source. However, this can be a ost economical method if necessary ite preparation is done ahead of time. or artificial seeding the landowner ust assure himself that seed can be urchased. There are several forest eed dealers in the Pacific Northwest hc maintain seed inventories. Their ams are available on request.

If there are any adverse conditions to seeding the landowner should consider planting instead. Planting procedures are discussed on pages 13 and 14.

SITE PREPARATION

Very often site preparation prior to planting or seeding will be one of the major cost items in reforesting older cutovers. On recently cutover lands this can be more economical. This is a major reason why the landowner should provide for prompt reforestation after logging.

Site preparation includes such jobs as slash disposal, scarification and brush control.

Slash disposal is more likely to be required on recently cutover lands. Careful consideration should be made of the need and method used. Slash disposal methods include broadcast burning, machine piling and hand piling with or without burning.

Broadcast burning is the most controversial method. The small landowner's need for this method is generally limited. A certain amount of soil and watershed damage occurs during burning. By careful choice of the burning time, however, excessive damage to soil, watershed, or residual trees can be avoided. Often, it is only necessary to burn slash concentrations. This might then create adequate areas for planting or seeding.

Machine piling will often accomplish two purposes--slash disposal and scarification. This work can be done at any time of year except when soil is water saturated. Soils are severely damaged at this time. When weather conditions permit, slash can be burned during the process of piling. The cost of the operation may be increased if burning is done at a later time. Only tractors equipped with brush blades or similar equipment should be used for piling.

Scarification is sometimes needed prior to seeding. Many times ample soil disturbance is caused by the logging.

Neither machine piling or scarification is advised on slopes greater than 30% because soil erosion increases greatly at this point.

A reforestation project on private land in Washington. The area was scarified by a bulldozer in 1964. It was then seeded by helicopter during the winter.

BRUSH CONTROL

Knowledge and skills about brush control methods have increased greatly in recent years. Many new chemical herbicides have been developed. Application methods have also become much more efficient.

There are several types of brush control to consider here. First is the control of brush fields or stands of so-called "weed trees" so that a stand of forest trees can be established. Second is the release of an established plantation or stand of natural seedlings suppressed by brush or weed trees. For this publication, we will be concerned with the first type of control.

One of the first rules in reforestatio is to establish a stand of forest tree on logged land before the brush itself becomes established. In brush problem areas it is best to plant the first ye after logging. Sometimes it is desirable to use large seedlings or transplants in order to get ahead of the brush.

On the older cutover, poorly stocked forest lands, brush control may be the largest single cost item in the reforestation program.

Brush Types

There are many brush types in the Pacific Northwest. They vary from Coastal area types that include salal, vine maple, salmonberry, thimbleberry and alder to interior mountain types that include ceanothus and manzanita. Bigleaf maple and Oregon oaks are othe important brush and weed tree types. Hardwood trees such as alder and bigleaf maple are considered weed trees only when growing on poor sites where they will not mature properly.

Brush Control Methods

Methods of brush control can be groupe in three classes. These are chemicals mechanical or combination.

Chemical control consists of using herbicides or poisons. These may be applied to either crowns or stems of plants. A crown application before the plant leaves out in the spring is called a dormant spray. After the plant has leaved out the crown application is called a foliar spray.

Dormant foliar sprays may be applied from the air by helicopter or from the ground using back pack sprayers, mist blowers or larger machine sprayers.

Stem application using ground equipmen is referred to as basal spraying. The chemical is sprayed on the bark of the tree or bush using ground or back pack spray equipment. Be sure to cover entire base of the stem for at least 6 to 18 inches in height.

bicides must be used safely accord-
to the manufacturers' directions.
ay when air is calm to avoid drift.
mant treatments often eliminate
risk of damaging adjacent farm
ps.

areas of 40 acres or more consider
ial application. Although helicop-
costs are high per hour the amount
area that can be treated in a short
e makes the cost per acre very
sonable. There are a sufficient
ber of experienced contractors in
Pacific Northwest so that the land-
er can obtain competitive bids.

landowner is advised to have a
tten contract that clearly defines
responsibilities of each party.
s is true for any type of refores-
ion work that is contracted.

most commonly used herbicides are
-D; 2,4,5-T; Silvex, and Amitrol.

se herbicides are then mixed with
riers such as water or oil for
ication. These herbicides are
ulated for specific purposes.
se them properly, some understand-
of terms is necessary.

r formulations of high or low vol-
ity are used in the oil spray.
volatility is usually preferred
use of less drift hazard.

s of herbicide acids are used in
r solutions. Amines are in this
s.

sifiable esters are used in sus-
ion formulations where the carrier
be either water, oil or a combin-
n, depending upon the intended
ose.

icides are generally manufactured
formula of four pounds of acid
edient per gallon. For applica-
the term "aehg" is used to desig-
the acid equivalent per hundred
ons of solution. Thus if 12 aehg
recommended it would mean three
s of chemical mixed with 97 parts
arrier.

Applying a foliar spray with a back pack mist blower. Herbicides in carriers of either water or oil can be applied as foliar or dormant sprays. This method is practical for small areas that can be reached by a man on foot.

Loading a helicopter with herbicide for use on a dormant spray project. This is the most economical method for treating large areas. The truck on the left is hauling the herbicide and carrier--in this case, diesel oil. The truck on the right is used for servicing the helicopter. (This photo courtesy of Larry Fick)

Recommendations for Chemical Use:

The following tables contain recommendations for the chemical control of common brush and weed tree species of the Pacific Northwest. These tables are based on the information provided in the Woodland Handbook for the Pacific Northwest--Brush Control Section by Michael Newton.

Aerial Spray Treatment for General Control

Species	Season	Chemical 1/	Pounds/Acre	Carrier & Vol/A
Vine Maple	March-April	2,4,5-T	2	10-gal. diesel
Red Alder				
0-20' tall	June-July 2/	2,4-D	2	8-gal. water
	Mar-April 3/	2,4-D	2	10-gal. diesel
20-40' tall	June-July	2,4-D	3	8-10 gal. wat
	Mar-April	2,4-D	3	10-12 gal. die
40' + tall	June-July	2,4-D	3	10-gal. water
	Mar-April 4/	2,4-D	3	12-gal. diesel
Manzanita	Mar-July	2,4-D	2	5-gal. water & 5% diesel
Ceanothus	Mar-April	2,4,5-T	2	5-gal. diesel
	June-July	2,4,5-T	2	5-gal. water + 5% diesel
Madrone	Mar-April	2,4,5-T	2	10-gal. diesel
	June-July	2,4,5-T	2	10-gal. water + 5% diesel
Tan Oak Live Oak Chinkapin	Mar-July	2,4,5-T	3	10-gal. water + 5% diesel

1/ Chemicals should be low volatile esters.

2/ Foliar application. Care should be taken not to exceed recommendations, or understory conifers may be damaged. Treatment not effective on understory salmonberry.

3/ Dormant application.

4/ If salmonberry understory is extensive, use a 50-50 mix of 2,4-D and 2,4,5-T.

Basal Sprays for the Large Hardwood Species

cies	Size Class d.b.h.	Season	Chemical	Formulation in Diesel Oil
leaf Maple	0"-6"	Any	2,4,5-T	12 aehg
" "	0"-6"	"	Silvex	"
" "	6" +	Mar-Sept.	"	"
gon White Oak	All	Mar-Aug.	2,4,5-T	16 aehg
ck Oak	"	Mar-Aug.	2,4,5-T	16 aehg
Alder	0"-6"	Mar-Aug.	2,4,5-T	16 aehg
"	6" +	May-July	"	"
e Maple	All	Any	2,4,5-T	12 aehg
rone	"	Mar-Sept.	"	"

Injection & Frill Treatment

ies	Size Class d.b.h.	Season	Chemical	Concentration
eaf Maple	All	Mar-Sept.	Tordon 2,4,5-T Amine	Undiluted "
on White Oak	All	All	2-4-D Amine	Undiluted
k Oak	All	All	2,4-D Amine	"
Alder	All	April-July	2,4-D Amine	"
one	All	All	2,4,5-T Amine	"
onwood	All	April-July	2,4-D Amine	"

High Volume Foliage Spray
For Brush and Shrubs Less than 20 feet tall

Species	Season	Chemical	Concentration	Carrier*
Blackberries	June-July	2,4,5-T	4 aehg	water
Poison Oak	June-Aug.	Amitrol-T	4 "	"
Hazel Snowberry Ribes	June-July	50-50 mix) 2,4-D &) 2,4,5-T)	4 aehg	water
Manzanita	Mar-July	2,4-D	2	water + 5% diesel
Ceanothus	Mar-July	2,4,5-T	2	water + 5% diesel
Chinkapin	May-July	2,4,5-T	4	water + 5% diesel
Scrub tanoak Canyon live oak	May-July	2,4-D)	4	water + 5% diesel
Serviceberry	May-July	2,4-D	4	water

*Carriers should contain wetting agents. Household detergents may be used.

Mechanical brush control involves any of the following methods:

1. Removal of brush by tractor equipped with a brush blade or comparable equipment.

2. Cutting down the brush or weed trees.

3. Girdling by removing a strip of bark completely around the trunk of the weed tree.

Use of Mechanical Methods. Normally this method of brush control will be more expensive than use of chemicals but in certain situations it may be more useful or desirable.

The major situation is where the brush concentration is so thick that even when dead it seriously hinders planting or seeding. Complete removal by machine in this case will make a very favorable seedbed or planting site.

It is important to be sure that brus roots are completely removed from th soil. Making a practice of having brush piles rolled completely over will insure this. It is generally not necessary to burn these piles. This increases costs greatly. Howev this might be necessary in areas hav a high population of rabbits. If bu ing is not practical some method of rabbit control will be needed. Control procedures are discussed in the animal control section.

Mechanical brush control, such as cutting or girdling, is also feasibl when brush or weed trees are widely scattered or on small areas where the cost of acquiring other equipment would be too great. Generally it is best to use a combination control method to avoid excessive sprouting.

Combination brush control involves the use of mechanical means plus application of a herbicide. A combin ation brush control method is best suited for areas of scattered weed

es, large weed trees, small areas areas too steep for tractors. chemical recommendations are tained in the chart on frilling.

1. This might involve treating stumps with a chemical after cutting trees or brush. Also, after girdling by applying chemical to the girdled area. For brush that has a tendency to sprout, the combination method is recommended rather than just cutting or girdling.

2. Frilling-chemical treatment. This method consists of making a series of cuts or gashes around the tree and then applying a small amount of concentrated chemical to the cuts.

   Tools called tree injectors have been developed so that both operations are done at one time. This is quicker and more economical than using an axe and an oil can, for example.

LIFE OR RODENT CONTROL

plantation failures can be attributo rodents and other animals.

s are eaten by mice, squirrels and r small mammals. It is now gen- practice to protect seed with llents. Sometimes it may be neces- to do additional control, such oisoning or trapping.

ted trees and seedlings are also ect to damage by small mammals, its, deer,mountain beaver and r animals. Planting stock can reated with a repellent before ping from the nursery and will ide protection for one season.

it populations in brush areas have to be controlled before ing or planting. The proper use oisoned bait has proven most essful. West of the Cascades e is used, while east of the ades alfalfa is best.

These baits are dusted with powdered strichnine alkaloid.

A rabbit control bait station on a reforestation project in Washington. Strichnine blocks are placed inside the large box.

Trapping can also be effective on small areas. Either live traps or Conibear traps baited with apple or alfalfa can be used.

The use of large planting stock is another method of reducing losses caused by animal damage. These trees will be at least 3 and often 4 years old. Landowners will often transplant natural seedlings, called wildings. These can be pulled during winter months when the ground is saturated. Sometimes these trees can be obtained along cut banks of roads. Never remove trees without the owner's permission, however.

SEEDING

If seeding is considered feasible, the landowner has a choice of spot or broadcast methods.

Spot seeding has several advantages. First, less seed is used. Also, the best spot for a tree to grow can be picked. However, this method requires more time and manpower for the job.

Broadcast seeding is the most common method. Hand broadcast seeding is usually reserved for small areas, while on larger areas helicopter seeding is most economical.

Regardless of the seeding method used there are certain basic principles that should be followed.

1. Choose favorable areas with exposed mineral soil. Avoid hot, dry south slopes.

2. Seed should be treated with a rodent repellent such as endrin or tetramine. A color coating is also needed to make seed unattractive to birds. The seed treating is a specialized job that is best done by the seed dealer at time of purchase. There are certain safety measures that must be followed when handling treated seed.

    a. Avoid breathing dust.

    b. Wear gloves.

    c. Wash hands thoroughly after handling seed.

    d. Do not eat, drink, or smoke while handling seed.

3. The recommended sowing rate per acre for broadcast seeding is:

Douglas-fir	1/2 to 1 lb.
Ponderosa Pine	1 to 1-1/2 lb.
Hemlock and Spruce	1/4 lb. of each mixed with 1/2 lb. of Douglas-fir

4. The best time for seeding is in the winter. If snow conditions limit access to the area, seed in the fall before snow rather than in the spring. Broadcast seeding can be done on a thin layer of snow early in the winter. Avoid seeding on deep snow on slopes. Melting snow may move too much seed down hill.

<u>How to Seed</u>. Aerial broadcast seeding should be done by contractors having suitable equipment. Names of contractors are available upon request.

Hand broadcast seeding is best done using a mechanical device such as the cyclone seeder. A waterproof seed container has been developed to protect seed during wet weather.

Spot seeding is done by placing several seeds (3-5) in spots spaced about 8 feet apart. Other spacing can be used if desired. When using treated seed a "walking stick seeder" or other dispensing device should be used to avoid excessive handling.

Seeding Douglas-fir with a modified cyclone seeder. Note the waterproof metal box.

PLANTING

There are several types of tree planting methods based upon the way the hole is made. These are the plow-type machine, soil auger and hand planting methods.

hine Planting. Where suitable, hine planting is the most eco- ical method. Machine use is limited such conditions as steep ground, ks, brush, debris, excessive slash stumps. There is considerable est land on the east side that can machine planted. On the west side est lands, however, there is little ortunity to use machines because of steep ground and other obstacles.

il recently most tree planting ines were adaptations of agricul- l type machines. They can be er free floating and pulled with actor or else mounted on a three- t hitch. Neither type has been for rough, brushy land. However, 963 several models of brushland ting machines became available. e are mounted on a crawler tractor can plant on ground unsuited for older types.

ecently developed planting ahine for use on forest land. Th planter is mounted on the rctor. Two-year-old Ponderosa Pie is being planted.

The small landowner, who contracts for or hires someone to machine plant, should make provision for prompt inspection of the job. Progress is so rapid that considerable investment in trees and other work can be lost if poor planting is tolerated for any length of time.

Soil Auger Planting. Two basic types of soil augers have been developed to use on ground unsuited for other planting machines. The first type has the auger mounted directly on a power saw motor. The second is an adaptation of another machine where the motor is carried on the operator's back with power transmitted to the auger by a cable.

A tree planting soil auger

Planting a 3-year-old Douglas-fir in the hole prepared by the auger. A stick is used to tamp soil firmly around the roots.

Hand Planting. Hand planting is still the method used by the majority of small woodland owners. Planting hoes or shovels are the basic tools used. Numerous publications about planting trees are available from your County Agent, Extension Forester or Farm Forester.

Planting Practices. Regardless of the tree planting method there are certain practices that should be followed to insure maximum seedling survival.

1. Protect seedlings before planting. After seedlings arrive from the nursery protect them by storing in a cool place or heeling in if they cannot be planted within a few days. Also during planting, prevent the roots from drying. Once the roots dry out, the seedling will die.

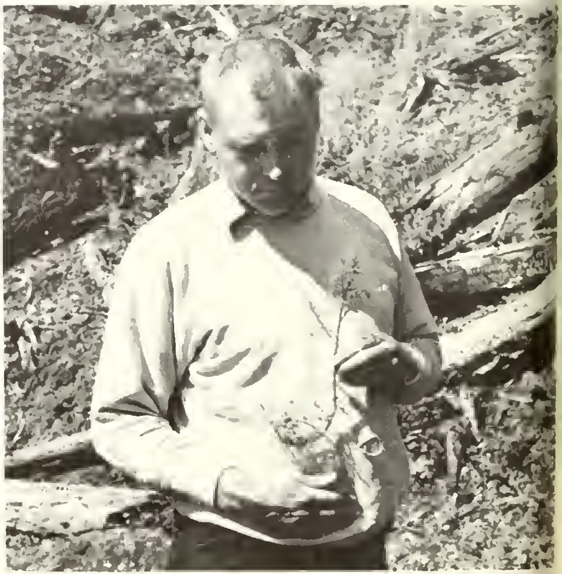
2. Select good planting site. Natural shading provided by a stump or log will help the seedling survive. Good soil is also needed. Avoid rotten wood or heavy duff unless it can be scraped away first. In selecting the planting spot, scalp vegetation and debris to expose mineral soil.

3. Make an adequate planting hole. The hole must be deep enough so that all the seedling's roots can be placed straight down or in the natural position.

4. Plant seedling at proper depth. The seedling should be placed at least as deep as it grew in the nursery. All roots must be in the ground but avoid burying any of the crown.

5. Pack soil around roots. Moist soil should be firmly packed around the roots, especially at the bottom of the hole. Improper packing may leave air space around the roots. Avoid putting roc and chunks of wood against the roots in the hole.

A Good Planting Practice
This tree was placed to receive natural shading. It has survived one summer. It has also been lightly browsed.



A Poor Planting Practice
Evidence and result of careless planting. This tree was placed in a shallow hole and roots bent into a "J" shape. This tree was turning brown when pulled and examined.

icing

fore any further planning can be done
e landowner must decide on spacing.
is is directly related to the purpose
the forest.

e usual practice in planting for a
ure timber crop has been to use an
x 8' spacing. This would be about
) trees per acre if all spacing was
rect. Normally this is not possible
forest land because of stumps and
er obstacles so that generally
ut 600 trees will be planted.

ent examinations of plantation spac-
tests established in 1925 indicate
t 10' x 10'spacing gives fastest
wth combined with good form and
ll limbs. The last spacing requires
trees per acre. This wider spacing
nits the landowner to use larger,
e expensive planting stock; do a
e careful planting job and still
p the cost of the job within reason-
e limits.

STANCE TO THE LANDOWNER

stance, both in the form of advice
cost-sharing is available to the
l woodland owner. A Farm Forester
ther technical forestry advisor
our county will provide advice and
rmation about any phase of refores-
on.

es for planting forest land are
ilable at cost from State forest
eries. Residents of the State of
ington may write to:

Webster State Nursery
Route 4, Box 425 A
Olympia, Washington

dents of Oregon may write to:
State Forester
P.O. Box 2289
Salem, Oregon 97310

er are several private nurseries in
gon and Washington that sell forest
tree seedlings at reasonable cost.
Their names and addresses are available on request.

Financial assistance for tree planting is available through the Agricultural Conservation Program. Details may be obtained from the Agricultural Stabilization & Conservation Service office in your county. Your Farm Forester can also provide information about this program.

For the name of the Farm Forester or other forestry advisor in your area, contact your County Agent or write to:

State Forester
P.O. Box 2289
Salem, Oregon 97310

Supervisor
Department of Natural Resources
Olympia, Washington

or

Regional Forester
P.O. Box 3623
Portland, Oregon 97208

Reference material:

Woodland Handbook for the Pacific Northwest Cooperative Extension Service, Oregon State University

"Your Trees--A Crop"
Douglas-fir Second Growth Management Committee

"Plant Your Trees Right"
PNW Bulletin No. 33

"Planting Forest Trees on Old Fields"
Carl L. Hawkes & Benjamin J. Mason

"Planting California Forest Land"
Ed E. Gilden, Ronald S. Adams and Carl L. Hawkes

"Protecting Forest Trees and Their Seed from Wild Mammals" M. A. Radwan

Tree Planter's Notes (various articles)
Volume 1-60.

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

PACIFIC NORTHWEST REGION—STATE AND PRIVATE FORESTRY

PORTLAND, OREGON

No. 11 April 1971

REFORESTING CUTOVER WOODLAND IN THE PACIFIC NORTHWEST

Prepared by Lloyd Soule and Walter Thomson in 1965; current revision by Frank Ter Bush of the Division of State and Private Forestry, USFS, with guidance and assistance of: Oregon State Board of Forestry; Washington Dept. of Natural Resources; Forest Research Laboratory at Oregon State University; Oregon and Washington Extension Services.

CONTENTS

FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

A. INTRODUCTION

Throughout the Northwest, literally millions of acres of commercial forest land require reforestation. Industrially-owned forest lands are now being reforested at rates never before attained. Much of the woodland in the small ownership class (less than 5,000 acres) is not as fortunate and remains unproductive. Lands needing reforestation fall into three main classes, namely:

1. Marginal agricultural.
2. Recent cutover.
3. Older, poorly-stocked cutover.

This "How-To-Do-It" is not primarily concerned with planting agricultural land. This deserves special treatment and the Farm Foresters are the best source of advice in this matter.

Reforestation is most readily accomplished on recent cutovers. Site preparation costs are moderate and reforestation success is more probable. Poorly-stocked, older cutover involves more site preparation and, hence, more expense. (Up to $100 per acre in some cases.) Many small landowners are not aware of the technical difficulties they will encounter in a reforestation program. The objective of this "How-To-Do-It" Guide is to bring together under one cover the information a small landowner needs to establish trees on forest land.

B. THE LANDOWNER'S PROGRAM

Before a landowner starts a reforestation program he should ask himself several questions:

1. What will be the final forest product; the intermediate products?

2. What species of trees should be grown?

3. What is my plan for accomplishing the job?

 a. Should I seed or plant?

 b. Do I need site preparation, brush control, rodent control, or any other kind of work?

 c. What methods do I use to do the job?

4. Where do I get trees or other material needed?

The Landowner's Problem

What Species?

Site Preparation?
Burn?
Pile Brush?
Scarify?
Spray?

Plant?
Size?
How?
Hand?
Machine?
Auger?

Seed?
Direct?
Broadcast?
Hand?
Aerial?

Animal Control?

1. **The Final Product.** The forest can have several uses and produce several kinds of products before the final harvest. However, the private landowner will generally have to decide on the most profitable land use. This might be growing timber, Christmas trees, or use as a recreation area. Even though timber is the final product, material such as pulpwood, posts, or poles can be harvested prior to the final cut. Also, many forms of recreation use are compatible with growing forest products when harvesting methods are modified to accommodate such use. For the purpose of this guide we will assume that timber is to be the final product.

2. **The Species of Trees.** Experience and studies show that the native trees of the Pacific Northwest are superior to introduced species for most uses. The best guide to follow is to consider what originally grew in the area. East of the Cascade Mountains it will often be ponderosa pine. West of the Cascades it will

often be Douglas-fir. Along the Coast, Sitka spruce and western hemlock can be mixed with the Douglas-fir. Recent studies indicate that, given special handling, hemlock (being shade tolerant) can be successfully used in under-planting. Deer damage is less of a problem with this species.

If native tree species are used, the landowner should match the seed source as closely as possible with the planting site. The elevation of the seed source should be within the same 1,000 foot elevation range. It should also have a similar geographic location. Seed dealers and tree nurseries keep records of the seed origin so that the landowner can obtain suitable source identified or certified seed or seedlings.

3. **The Plan for Accomplishment**. Before the landowner can make a reforestation plan he must have some basic information about his land.

Much of this can be obtained while making a stocking survey. This is done by simply walking through the area or by using a formal systematic method. No matter what system is used the following things should be determined.

a. Number of natural seedlings per acre.

b. Areas overstocked or understocked.

c. Areas where brush suppresses seedlings.

d. Areas of intensive rodent or other wildlife population and uses.

e. Areas unsuitable for trees; such as rock outcroppings, swamps, etc. A map showing these areas is helpful when determining acres needing treatment.

A small amount of time spent in making this simple examination will enable the landowner to plan a more economical and practical reforestation job.

Here is a simple procedure to use in making a formal stocking survey:

Use 1/250-acre circular plots. These have a radius of 7.45 feet.

Follow a compass line across the area. Travel in a cardinal direction if possible. This reduces chances for error in direction and makes mapping easier.

Lines should be 5 chains (330 feet) apart. Plots should be 1/2 or 1 chain apart (33 to 66 feet) on the lines. This depends on size of the area. For areas less than 40 acres the 1/2-chain interval is recommended. Number plots consecutively. These can be plotted on a simple map and will show problem areas, etc.

Tally the stocking on each plot as follows:

- S – Satisfactory, one or two seedlings or saplings.
- 0 – Unstocked, no trees.
- + – Overstocked, more than two trees per plot.
- U – Unsatisfactorily stocked, trees present but unable to grow because of brush suppression, animal damage, or other factors.

Also tally other items, including area plantable, area not plantable, needing brush control, animal damage (deer, rodents, mountain beaver, gopher, etc.), heavy slash, and areas needing pest control.

Once a landowner has inventoried and mapped his area he can make a practical plan. The plan might include the following items:

a. Areas adequately stocked.

(1) Release needed, chemical or mechanical.

(2) Precommercial thinning needed.

b. Areas inadequately or unstocked.

(1) Site preparation needed, chemical or mechanical.

(2) Areas suitable for seeding. Northerly aspects. Scarification needed.

(3) Areas to be planted. Spacing, species, age class of seedlings, planting method.

(4) Areas unsuited for trees, bogs, rock outcroppings.

(5) Wildlife control needed.

A landowner may not encounter all the problems or conditions that have been mentioned. He should, however, be on the lookout for them.

C. TO SEED OR TO PLANT

This is a major decision for the landowner. Some basic principles must be considered in order to develop a sound answer. Seeding is usually the most economical method when

conditions are favorable. Determining the suitability of these conditions includes considering such items as: Aspect, topography, ground conditions, soil types, animal population, and availability of seed.

Two Reforestation Methods

Loading a helicopter with tree seed.

Planting 3-year-old Douglas-fir with a planting hoe.

Aspect. This is the direction that a slope faces and is directly related to exposure to the sun. Slopes with north, northeast, or northwest aspects are much more favorable for seeding than south, southeast, or west aspects. Seeding is seldom successful in southern Oregon.

Topography. Steepness of slope generally does not prevent successful seeding. In fact, seeding is less costly than planting steep rocky slopes when other conditions such as aspect are favorable.

Ground conditions. Tree seeds, especially Douglas-fir and ponderosa pine, require a mineral soil seedbed for best germination and growth. This has been demonstrated by numerous research studies. Logging usually causes enough soil disturbance to create adequate seedbeds. Because of this, prospects for seeding recently logged areas are often good.

Soil types. Most forest soils will be fertile enough to support tree growth. Some types, such as deep pumice, are subject to severe drought. In order to obtain satisfactory stocking, it may be necessary to use special planting stock and methods or other required treatment.

Animal populations. Excessively large numbers of animals that eat seeds or seedlings must generally be controlled first to insure satisfactory stocking.

Availability of seed. Seeding can be done by natural or artificial means. Natural seeding can be done only during good seed years with an adjacent seed source. However, this can be a most economical method if necessary site preparation is done ahead of time. For artificial seeding the landowner must assure himself that seed can be purchased. There are several forest seed dealers in the Pacific Northwest who maintain seed inventories. Their names are available on request.

If there are any adverse conditions to seeding, the landowner should consider planting instead. Planting procedures are discussed on pages 11 to 13. It is only fair to warn that seeding carries a higher risk of failure than planting.

D. SITE PREPARATION

Very often site preparation prior to planting or seeding will be one of the major cost items in reforesting older cutovers. On recently cutover lands this can be more economical. This is a major reason why the landowner should provide for prompt REFORESTATION AFTER LOGGING.

Site preparation includes such jobs as slash disposal, scarification, and brush control.

Slash disposal is more likely to be required on recently cutover lands. Careful consideration should be made of the need and method used. Slash disposal methods include broadcast

burning, machine piling, and hand piling with or without burning.

Broadcast burning is the most controversial method. The small landowner's need for this method is generally limited. A certain amount of soil and watershed damage occurs during burning. By careful choice of the burning time, however, excessive damage to soil, watershed, or residual trees can be avoided. Often, it is only necessary to burn slash concentrations. This might then create adequate areas for planting or seeding.

Machine piling will often accomplish two purposes – slash disposal and scarification. This work can be done at any time of year except when soil is water saturated. Soils are severely damaged at this time. When weather conditions permit, slash can be burned during the process of piling. The cost of the operation may be increased if burning is done at a later time. Only tractors equipped with brush blades or similar equipment should be used for piling. This insures better cleanup due to less dirt in the piles.

Scarification is sometimes needed prior to seeding. Many times, ample soil disturbance is caused by the logging.

Neither machine piling or scarification is advised on slopes greater than 30 percent because soil erosion increases greatly at this point.

A reforestation project on private land in Washington. The area was scarified by a bulldozer in 1964. It was then seeded by helicopter during the winter.

E. BRUSH CONTROL

Knowledge and skills about brush control methods have increased greatly in recent years. Many new chemical herbicides have been developed. Application methods have also become much more efficient.

There are several types of brush control to consider here. First is the control of brush fields or stands of so-called "weed trees" so that a stand of forest trees can be established. Second is the release of an established plantation or stand of natural seedlings suppressed by brush or weed trees. For this publication, we will be concerned with the first type of control.

One of the first rules in reforestation is to establish a stand of forest trees on logged land before the brush itself becomes established. In brush threat areas it is best to plant the first year after logging. Sometimes it is desirable to use large seedlings or transplants in order to get ahead of the brush.

On the older cutover, poorly-stocked forest lands, brush control may be the largest single cost item in the reforestation program (sometimes over $50 per acre). Occasionally owners can combine acreages and let one contract to realize lower unit costs.

1. **Brush Types.** There are many brush types in the Pacific Northwest. They vary from Coastal area types that include salal, vine maple, salmonberry, thimbleberry, and alder to interior mountain types that include ceanothus and manzanita. Bigleaf maple and Oregon oaks are other important brush and weed tree types. Hardwood trees such as alder and bigleaf maple are considered weed trees only when growing on poor sites where they will not mature properly.

2. **Brush Control Methods.** Methods of brush control can be grouped in three classes. These are chemical, mechanical, or combination.

3. **Chemical control** consists of using herbicides. These may be applied to either crowns or stems of plants. A crown application before the plant leaves out in the spring is called a dormant spray. After the plant has leaved out the crown application is called a foliar spray.

Dormant and foliar sprays may be applied from the air by helicopter or from the ground using back pack sprayers, mist blowers, or larger machine sprayers.

Stem application using ground equipment is referred to as basal spraying. The chemical is sprayed on the bark of the tree or bush using ground or back pack spray equipment. Be sure to cover entire base of the stem for at least 6 to 18 inches in height.

Weed trees can be killed by injecting a concentrated herbicide. A hatchet and oil can is sufficient for small jobs. Specialized equipment is available for use over larger areas.

A wide selection of compounds are available for injection. Some are so effective that only very small volumes are needed to deaden undesirable trees. See Table 2 for recommended chemicals and dosages.

Herbicides must be used safely according to the manufacturers' directions. Spray when air is calm to avoid drift. Dormant treatments often eliminate the risk of damaging adjacent farm crops.

On areas of 40 acres or more, consider aerial application. Although helicopter costs are high per hour the amount of area that can be treated in a short time makes the cost per acre very reasonable. There are a sufficient number of experienced contractors in the Pacific Northwest so that the landowner can obtain competitive bids.

The landowner is advised to have a written contract that clearly defines the responsibilities of each party. This is true for any type of reforestation work that is contracted.

The most commonly used herbicides are 2, 4-D; 2,4,5-T; Silvex, and Amitrol.

These herbicides are then mixed with carriers such as water or oil for application. These herbicides are formulated for specific purposes. To use them properly, some understanding of terms is necessary.

Ester formulations of low volatility should be used in the oil spray. Low volatility is preferred because of less drift hazard. Emulsifiable formulations can be used in oil or water.

Salts of herbicide acids are used undiluted in injectors. Amines are in this class. These salts are seldom used in broadcast applications.

Herbicides are generally manufactured in a formula of 4 pounds of acid ingredient per gallon. For application the term "aehg" is used to designate the acid equivalent per hundred gallons of solution. Thus if 12 aehg is recommended it would mean 3 parts of chemical mixed with 97 parts of carrier.

Loading a helicopter with herbicide for use on a dormant spray project. This is the most economical method for treating large areas. The truck on the left is hauling the herbicide and carrier – in this case, diesel oil. The truck on the right is used for servicing the helicopter. (This photo courtesy of Larry Fick)

4. **Mechanical brush control** involves any of the following methods:

a. Removal of brush by tractor equipped with a brush blade or comparable equipment.

b. Cutting down the brush or weed trees.

c. Girdling by removing a strip of bark completely around the trunk of the weed tree.

Use of Mechanical Methods. Normally this method of brush control will be more expensive than use of chemicals but in certain situations it may be more useful or desirable.

Table 1. — Recommendations for Broadcast and Spot Spraying, by Species.

Species	Method	Chemical	Pounds per acre, or concentration	Gallons per acre; carrier	Season	Remarks
Alder	Aerial dormant	2,4-D	2*[1]	10,oil	Bud burst	Fair-good
		2,4,5-T	2*	10,oil	Bud burst	Like 2,4-D
	Aerial foliage	2,4-D	2*	10,H_2O	Full leaf	
Blackberries	Spot spray	2,4,5-T	4 aehg[2]	100,H_2O	Summer	Some sprouting
		Picloram	2 aehg	100,H_2O	Summer	Good
		Amitrole	8 aehg	100,H_2O	Summer	Good
Bitter cherry	Aerial foliage	D-T Brush-killer	2*	10,H_2O	Summer	Poor, but dormant worse
Bigleaf maple	No broadcast methods work well for this species.					
Chinkapin	Aerial	2,4,5-T 2,4-D	2*	10,H_2O-oil[3]	Mar.-Sept.	Fair control
Hazel	Aerial foliage	2,4-D	2-4*	10,H_2O	Summer	Heavy does best Dormant poor
Madrone	Aerial	2,4,5-T 2,4-D	2*	10,H_2O-oil	Mar.-Sept.	Vigorous sprouts
Manzanita spp.	Aerial	2,4-D	2*	5,H_2O-oil	Mar.-Sept.	May sprout
Salal	Summer foliage	Picloram	2 aehg[4]	100,H_2O	Summer	Variable results
Salmonberry	Spot spray	Amitrol-T	2*	10,H_2O	Late July-Aug.	
Thimbleberry	Spot spray	Brush-killer	2-4 aehg	100,H_2O	July	
	Aerial foliage	Brush-killer	4*	10,H_2O	July	Fair
Varnishleaf ceanothus	Aerial	2,4,5-T or mixture	2*	10,H_2O-oil	Mar.-Sept.	Best with 2,4,5-T
Vine maple	Aerial dormant	2,4,5-T	2*	10,oil	Mar.-Apr.	Foliage spray poor
All species (composite mixture)	Aerial dormant	Brush-killer	2-4*	10,oil	Mar.-May	One treatment of mixed species always promotes resistant brush. Use higher rates on old dense brush.
	Aerial foliage	Brush-killer	2-4*	10,oil-H_2O[3]	Summer	

[1] *Indicates pounds active ingredient per acre.

[2] Aehg indicates active ingredients equivalent per hundred gallons.

[3] H_2O-oil implies an emulsion of 5 to 20 percent diesel fuel in water. Higher concentrations of oil used in late summer.

[4] Residual picloram in soil may kill conifers planted after herbicide treatment.

Table 2. — Chemicals and Dosages Recommended for Injection of Western Tree Species. All Compounds Are Used Undiluted Unless Otherwise Specified, at a Volume of 1 ml./cut.

Species	Chemical	Inches between cut centers	Season	Expected results
Alder	2,4-D amine	3	Summer	Good
	Cacodylic acid	3	June-October	Good
	Picloram	6	May-October	Excellent
Bigleaf maple	Silvex, K-salt	3	March-October	Good] Excellent on
	MSMA	3	Summer	Good] small trees
	Picloram	3	Summer	Fair-good
Bitter cherry	2,4-D amine	6	Summer	Excellent
	Cacodylic acid	6	Summer	Excellent
	Picloram	9	Summer	Excellent
Black oak	2,4-D amine	3	Summer	Fair-good
	Picloram	3	Summer	Good
Chinkapin	2,4,5-T amine	3	Summer	These recommendations
	Picloram	3	Summer	have not been tested
	Cacodylic acid	3	Summer	widely, but should
	2,4-D amine			prove adequate.
Douglas-fir	MSMA	6	All	Excellent
	Cacodylic acid	5	All	Good
	MSMA & Cacodylic acid mix	6	All	Excellent
Grand fir	Cacodylic acid	4	All	Good]
	MSMA	4	All	Good] Based on limited
	Picloram	6	All	Good] data
Hemlock	MSMA	3	All	Good
	Picloram	3	All	Good — danger of root rot
	Cacodylic acid	3	All	Fair
Lodgepole pine	Cacodylic acid	5	All	Good
	MSMA	5	All	Good
	MSMA & Cacodylic acid mix	5	All	Good
Madrone	2,4,5-T amine	3	Summer	Recommendations for
	2,4-D amine	3	Summer	madrone not well tested
	Picloram	3	Summer	in field.
Noble fir	Cacodylic acid	5	All	Not thoroughly field
	MSMA	5	All	tested. Should prove
	MSMA & Cacodylic acid mix	5	All	effective in noble fir.
Oregon white oak	Picloram	6	All	Excellent
	Cacodylic acid	3	All	Good; fair in summer
	2,4-D amine	3	All	Good except in winter
Ponderosa pine	Cacodylic acid	5	All[1]	Substantial insect protection
	MSMA	5	All[1]	Good
	MSMA & Cacodylic acid mix	5	All[1]	Good
Sitka spruce	MSMA	4	All	Fair-good-best in winter
	Cacodylic acid	4	All	Top-kill only
	Picloram	6	All	Good, may root graft
All species	MSMA & Cacodylic acid mix	3-6	Summer-Fall	Poor sprout control on hardwoods, but should top-kill all species. Hardwoods require closer cut spacing than conifers.
	Picloram	3-9	Summer	Best all-around killer of trees. Serious residual activity near conifers, and widespread root grafting.

[1] Best in fall and winter.

Table 3. — Chemicals and Dosages for Control of Hardwoods by Basal Treatment.

Species	Chemical	Concentration in diesel, aehg[1]	Season	Remarks
Alder	2,4-D	10	Summer	Very resistant other seasons
Bigleaf maple	Silvex	12	All	Best spring and fall
Bitter cherry	Brush-killer	10	Summer	
Chinkapin	2,4,5-T	12	All	Not well field tested
Madrone	2,4,5-T	12	All	Very good in summer
Manzanita	2,4-D	10	Summer	
Salmonberry	Silvex, 2,4,5-T	6	Summer	Good
Vine maple	2,4,5-T	10	Spring-Summer	
White oak	2,4,5-T	16	Summer	Clearly better than silvex
Mixed species	2,4,5-T	12	Summer	Should be effective almost universally

[1] Active ingredients equivalent per hundred gallons.

The major situation is where the brush concentration is so thick that even when dead it seriously hinders planting or seeding. Complete removal by machine in this case will make a very favorable seedbed or planting site.

It is important to be sure that brush roots are completely removed from the soil. Making a practice of having brush piles rolled completely over will insure this. It is generally not necessary to burn these piles. This increases costs greatly. However, this might be necessary in areas having a high population of rabbits. If burning is not practical, some method of rabbit control will be needed. Control procedures are discussed in the animal control section.

Mechanical brush control, such as **cutting or girdling**, is also feasible when brush or weed trees are widely scattered or on small areas where the cost of acquiring other equipment would be too great. Generally it is best to use a combination control method to avoid excessive sprouting.

5. **Combination brush control** involves the use of mechanical means plus application of a herbicide. A combination brush control method is best suited for areas of scattered weed trees, large weed trees, small areas, or areas too steep for tractors. The chemical recommendations are contained in the chart on tree injection (Table 2).

a. This might involve treating stumps with a chemical after cutting trees or brush. Also, after girdling by applying chemical to the girdled area. For brush that has a tendency to sprout, the combination method is recommended rather than just cutting or girdling.

b. Frilling-chemical treatment method consists of making a series of cuts or gashes around the tree and then applying a small amount of concentrated chemical to the cuts.

Tools called tree injectors have been developed so that both operations are done at one time. This is quicker and more economical than using a hatchet and an oil can, for example (although the hatchet and oil can are adequate for small jobs).

F. WILDLIFE OR RODENT CONTROL

Many plantation failures can be attributed to rodents and other animals.

Seeds are eaten by mice, squirrels, and other small mammals. It is now general practice to

protect seed with repellents. Sometimes it may be necessary to do additional control, such as poisoning or trapping.

Planted trees and seedlings are also subject to damage by small mammals, rabbits, deer, mountain beaver, and other animals. Planting stock can be treated with a repellent before shipping from the nursery and will provide some protection until initiation of new growth.

Rabbit populations in brush areas will have to be controlled before seeding or planting. The proper use of poisoned bait has proven most successful. West of the Cascades, apple is used; while east of the Cascades, alfalfa is best.

These baits are dusted with powdered strichnine alkaloid.

A rabbit control bait station on a reforestation project in Washington. Strichnine blocks are placed inside the large box.

Trapping can also be effective on small areas. Either live traps or Conibear traps baited with apple or alfalfa can be used.

For more information contact the Bureau of Sport Fisheries and Wildlife, Division of Wildlife Services, 809 N.E. 6th, Portland, Oregon 97232.

The use of large planting stock is another method of reducing losses caused by animal damage, particularly that from deer. These trees will be at least 3 and often 4 years old. Landowners will often transplant natural seedlings, called wildings. This is occasionally useful in brushy coastal areas with stock 2½ or more feet tall. These can be pulled during winter months when the ground is saturated. Sometimes these trees can be obtained along cut banks of roads. Never remove trees without the owner's permission, however.

G. SEEDING

If seeding is considered feasible, the landowner has a choice of spot or broadcast methods.

Spot seeding has several advantages. First, less seed is used. Also, the best spot for a tree to grow can be picked. However, this method requires more time and manpower for the job.

Broadcast seeding is the most common method. Hand broadcast seeding is usually reserved for small areas, while on larger areas helicopter seeding is most economical.

Regardless of the seeding method used, there are certain basic principles that should be followed.

1. Choose favorable areas with exposed mineral soil. Avoid hot, dry south slopes.

2. Seed should be treated with a rodent repellent such as endrin. A color coating is also needed to make seed unattractive to birds. The seed treating is a specialized job that is best done by the seed dealer at time of purchase. There are certain safety measures that must be followed when handling treated seed.

   a. Avoid breathing dust.

   b. Wear gloves.

   c. Wash hands thoroughly after handling seed.

   d. Do not eat, drink, or smoke while handling seed.

3. The recommended sowing rate per acre for broadcast seeding is:

Douglas-fir	1/2 to 1 lb.
Ponderosa pine	1 to 1½ lb.
Hemlock and spruce	1/4 lb. of each mixed with 1/2 lb. of Douglas-fir

4. The best time for seeding is in the winter. If snow conditions limit access to the area, seed in the fall before snow rather than

in the spring. Broadcast seeding can be done on a thin layer of snow early in the winter. Avoid seeding on deep snow on slopes. Melting snow may move too much seed down hill.

How to Seed. Aerial broadcast seeding should be done by contractors having suitable equipment. Names of contractors are available upon request.

Hand broadcast seeding is best done using a mechanical device such as the cyclone seeder. A waterproof seed container has been developed to protect seed during wet weather.

Spot seeding is done by placing several seeds (3-5) in spots spaced about 8 feet apart. Other spacing can be used if desired. When using treated seed a "walking stick seeder" or other dispensing device should be used to avoid excessive handling.

Seeding Douglas-fir with a modified cyclone seeder. Note the waterproof metal box.

H. PLANTING

There are a number of tree planting systems. These include the plow-type machine, soil auger, hand planting, and container.

1. **Machine Planting.** Where suitable, machine planting is the most economical method. Machine use is limited by such conditions as steep ground, rocks, brush, debris, excessive slash, or stumps. There is considerable forest land on the eastside that can be machine planted. On westside forest lands, however, there is little opportunity to use machines because of the steep ground and other obstacles.

Until recently, most tree planting machines were adaptations of agricultural type machines. They can be either free floating and pulled with a tractor or else mounted on a three-point hitch. Neither type has been good for rough, brushy land.

A recently developed planting machine for use on forest land. The planter is mounted on the tractor. 2-year-old ponderosa pine is being planted.

The small landowner, who contracts for or hires someone to machine plant, should make provision for prompt inspection of the job. Progress is so rapid that considerable investment in trees and other work can be lost if poor planting is tolerated for any length of time.

2. **Soil Auger Planting.** Power saws are fitted with a 4- to 6-inch diameter auger, 20 to 30 inches long. This quickly digs a hole that permits a tree to be "planted like a rose." This allows better root distribution than is possible with other methods.

A tree planting soil auger.

Planting a 3-year-old Douglas-fir in the hole prepared by the auger. A stick is used to tamp soil firmly around the roots.

3. **Hand Planting.** Hand planting is still the method used by the majority of small woodland owners. Planting hoes or shovels are the basic tools used. Numerous publications about planting trees are available from your County Agent, Extension Forester, or Farm Forester.

4. **Container Planting.** Seedlings are grown under greenhouse conditions in small containers. This small planting stock is readily adapted to mechanical planting with a "planting gun" or a dibble. Nurserymen can take your order and deliver the planting stock in a fraction of the time normally required for conventional stock. Developed by Canadians, this technique is just beginning to be used in Northwestern reforestation efforts. Since the roots are not disturbed in planting, it is possible to extend the planting season in some cases.

5. **Planting Practices.** Regardless of the tree planting method, there are certain practices that should be followed to insure maximum seedling survival. Failure to follow these rules is a major cause of reforestation problems.

a. Protect bare root seedlings before planting. After seedlings arrive from the nursery, protect them by storing in a cool place or "heeling in" if they cannot be planted within a few days. Also during planting, prevent the roots from drying. Once the roots dry out, the seedlings are dead.

b. Select a good planting site. Natural shading provided by a stump or log will help the seedling survive. Good soil is also needed. Avoid rotten wood or heavy duff unless it can be scraped away first. In selecting the planting spot, scalp vegetation and debris to expose mineral soil.

c. Make an adequate planting hole. The hole must be deep enough so that all the seedling's roots can be placed in a natural position.

d. Plant seedling at proper depth. The seedling should be placed at least as deep as it grew in the nursery. All roots must be in the ground but avoid burying any of the crown.

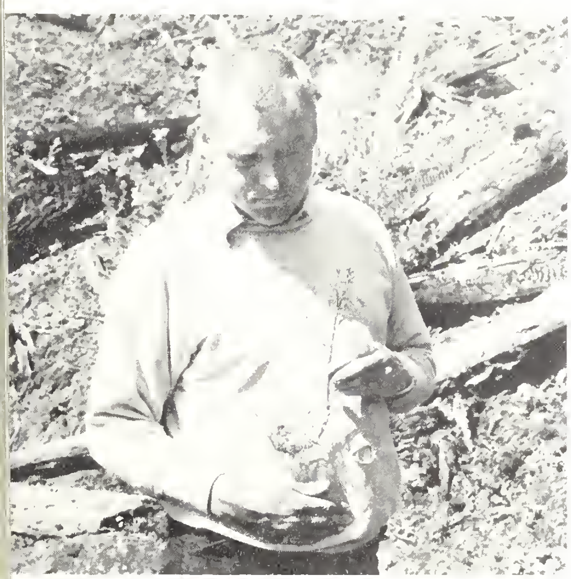
e. Pack soil around roots. Moist soil should be firmly packed around the roots, especially at the bottom of the hole. Improper packing may leave air spaces around the roots. Avoid putting rocks and chunks of wood against the roots in the hole.

f. Check with the local Farm Forester concerning planting season (spring or fall), frost heaving probability, and other details of the planting job. Some areas experience greater success with spring planting; in others, fall planting is desirable.

Frost heaving can be a real problem at times and undo considerable planting effort. Seedlings should never be planted in bone-dry soil. Know your local rainfall pattern and be guided accordingly.

A Good Planting Practice

This tree was placed to receive natural shading. It has survived one summer. It has also been lightly browsed.



A Poor Planting Practice

vidence and result of careless planting. This tree was laced in a shallow hole and roots bent into a "J" hape. This tree was turning brown when pulled and xamined.

6. **Spacing.** Before any further planning an be done, the landowner must decide on pacing. This is directly related to the purpose f the forest.

he usual practice in planting for a future mber crop has been to use an 8 by 8 foot pacing. This would be about 680 trees per cre, if all spacing was correct. Normally this not possible on forest land because of umps and other obstacles so generally about 00 trees will be planted.

Recent examinations of plantation spacing tests established in 1925 indicate that 10 by 10 foot spacing gives fastest growth, combined with good form and small limbs. The last spacing requires 430 trees per acre. This wider spacing permits the landowner to use larger, more expensive planting stock, do a more careful planting job, and still keep the cost of the job within reasonable limits.

I. ASSISTANCE TO THE LANDOWNER

Assistance, both in the form of advice and cost-sharing, is available to the small woodland owner. A Farm Forester or other technical forestry advisor in your county will provide advice and information about any phase of reforestation.

Trees for planting forest land are available at cost from State forest nurseries. Residents of the State of Washington may write to:

Webster State Nursery
Route 4, Box 424A
Olympia, Washington 98501

Residents of Oregon may write to:

State Forester
P.O. Box 2289
Salem, Oregon 97310

There are several private nurseries in Oregon and Washington that sell forest tree seedlings at reasonable cost. Their names and addresses are available on request.

Financial assistance for tree planting is available through the Rural Environmental Assistance Program (REAP). Details may be obtained from the Agricultural Stabilization & Conservation Service office in your county. Your Farm Forester can also provide information about this program.

For the name of the Farm Forester or other forestry advisor in your area, contact your County Agent or write to:

State Forester
P.O. Box 2289
Salem, Oregon 97310

Supervisor
Department of Natural Resources
P.O. Box 168
Olympia, Washington 98501

Regional Forester
Division of State and Private Forestry
P.O. Box 3623
Portland, Oregon 97208

J. REFERENCE MATERIAL

"Woodland Handbook for the Pacific Northwest"
Cooperative Extension Service
Oregon State University

"Your Trees – A Crop"
Douglas-fir Second Growth Management Committee

"Plant Your Trees Right"
PNW Bulletin No. 33

"Planting Trees in the Pacific Northwest"
Michael Newton, PNW Bulletin No. 120

"Planting California Forest Land"
Ed E. Gilden, Ronald S. Adams, and Carl L. Hawkes

"Protecting Forest Trees and Their Seed from Wild Mammals"
M. A. Radwan

"Tree Planter's Notes" (various articles)

(To be revised and put in Guide form as Guide #12)

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DEVELOPMENT OF A PLANTATION OF HIGH QUALITY SHEARED DOUGLAS-FIR CHRISTMAS TREES

(Step-By-Step Cultural Instructions)

A. Introduction

Shearing Douglas-fir for Christmas trees is a new and rapidly developing practice. Unsheared, naturally-shaped trees were the only kind available on the market until the last few years. They still dominate the market and will probably continue to be the type preferred by most buyers. However, the sheared tree is increasingly in demand by consumers who prefer a heavy, dense branch structure.

Relatively few growers are now producing high-quality sheared Douglas-fir Christmas trees. Those who do, find a strong demand at premium prices. The sellers' market for this type of tree will undoubtedly continue for a number of years until more growers produce them.

Best sites for developing plantations for sheared Douglas-fir Christmas trees are former agricultural lands where tree growth rate is intermediate (Site III). Slow tree growing lands (Sites IV and V) produce growth too slowly for good response after shearing and are usually better suited for growing naturally-shaped Christmas trees. Fast tree growing lands (Site I and high Site II) produce growth that is too rapid and unruly for easy control and are better suited for growing timber. Level or gentle southerly and westerly exposures appear to provide the best results.

Development to merchantable size is more rapid than for naturally-shaped trees. Many growers are able to produce marketable six- and seven-foot trees in only 6 or 7 growing seasons after planting.

. Planting

Spacing 5' x 5' is ideal for producing trees 5 to 7 feet tall. Somewhat wider spacing is recommended for producing taller trees. Perfect spacing of trees to form rows in each direction simplifies cultivating, mowing, spraying, and other cultural practices. This check-row pattern is difficult to attain with planting machines. Only a few machine

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planters have developed sufficient skill to do a good job. Hand planting a field marked in squares or along a wire marked at 5-foot intervals is still the most reliable method.

C. Weed and Grass Control

Douglas-fir plantations for developing sheared Christmas trees should be grass and weed free. This permits maximum growth rate, high rate of survival, and elimination of habitat for meadow mice and other destructive rodents.

Frequent cultivation for the first 2 or 3 years is the usual method. Chemical herbicides, as recommended by farm foresters and county agents, are becoming increasingly popular and are less costly than cultivation. Paper and plastic mulches can be effective but are usually more costly than the other two methods.

Mowing, or a combination of mowing and chemicals, is usually substituted for cultivation after the second or third growing seasons when the trees have become well established. If continued cultivation is preferred, the equipment should be small enough and the bottom tree whorls developed high enough above the ground to prevent mechanical injuries to the branches.

D. Cultural Techniques in Brief

1. Basal Pruning. Locate a good bottom whorl with 5 or more evenly spaced branches. It should be not less than 12" above the ground to permit an adequate handle, and, in any event, above heavy shade caused by grass and weeds.

   If the trees will eventually be replaced by planting, all branches below the bottom whorl should be cut flush with the bark. If stump culture is planned, a few small branches or sprouts should be retained between the bottom of the 9" handle and the ground.

2. Leader Pruning To Form a False Whorl. Locate a cluster of buds on the leader 12" to 16" above the top whorl. Locate a strong single bud 3" or 4" above the cluster and cut the leader 1/8" above it. Any additional buds between the cluster and the top bud should be picked off to discourage multiple leaders. At the same time cut back the branch tips of the top whorl about 1/8" above a pair of buds. This prevents them from turning up and forming multiple leaders. It also restores good proportion.

3. Shearing. Branch shearing is practiced to develop a symmetrical tree. The aim is to form a near-perfect inverted "V" shape. Two methods, random shearing or selective shearing, are used to accomplish this result. Random shearing is the quickest, most economical, and the most commonly used method. Branch ends are trimmed with a sharp, thin knife with a 14" to 16" blade. Sweeping, downward strokes are used. Hedge shears are sometimes used instead of a knife.

   Selective shearing is accomplished by removing branch ends individually with a hand pruner. Leave two opposite side buds, or a bottom bud about 1/8" from the cut, to insure future growth. Top buds within two inches from the cut should be removed to prevent the growth of branches that turn back toward the stem. This procedure is slower and more expensive than random shearing, but results in a more natural appearance.

E. Step-By-Step Cultural Instructions

1. After First Growing Season. Concentrate only on keeping the trees alive and growing. Weed and grass control is very important. The only pruning might be removal of double leaders or other obvious deformities.

2. After Second Growing Season. Same as first growing season for most trees. If exceptionally rapid growth develops a leader longer than 16 inches, refer to instructions for third year.

3. After Third Growing Season. If current year's growth is less than 14 inches, do not prune or shear. If current year's growth is 14 to 16 inches, basal prune only. If current year's growth is more than 16 inches, basal prune and also prune leaders to develop a false whorl about 14" above the base of the leader. Shear the tree to a perfect inverted "V" shape with a 50% taper.

4. After Fourth Growing Season. Same as after third growing season. Continue to prune any leaders that are longer than 16 inches and shear to a 50% taper. If multiple leaders form, the best one should be developed and the others either removed or cut short. In-pointing branches, suckers, and other obvious deformities should be removed with a hand pruner.

5. After Fifth Growing Season. Same as after fourth growing season.

6. After Sixth Growing Season. For trees that won't be ready to harvest by Christmas, do same as after fifth growing season. For trees that will be harvested for Christmas:

   a. Cut leader back to about 14" or 16" but develop a false whorl in case the tree is not harvested and will have to grow another year.

   b. Shear very lightly, preferably in early summer when new growth is fully elongated but not hardened off. Only tips of the longest branches should be trimmed off. Desirable taper is 60% to 75% for most trees. Obvious deformities such as in-pointing branches, multiple leaders, and suckers, should be corrected in a manner that will least detract from the appearance of the tree.

7. After Seventh Growing Season. Same as after sixth growing season. Most of the remaining trees will be harvested this year.

   The grower will have decided by this time whether he wishes to clear cut and start over with a new planting or to stump culture and develop an uneven-aged stand of Christmas trees. If stump culture is the desired practice, he should retain sufficient live branches or sprouts between the ground and the bottom of the handle to keep the roots alive.

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

PACIFIC NORTHWEST REGION—STATE AND PRIVATE FORESTRY

12 PORTLAND, OREGON November 1967

DEVELOPMENT OF HIGH QUALITY SHEARED DOUGLAS-FIR CHRISTMAS TREES

CONTENTS Page

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nd member growers of the N. W. Christmas Tree Assoc.

FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

DEVELOPMENT OF HIGH QUALITY SHEARED DOUGLAS-FIR CHRISTMAS TREES

. INTRODUCTION

his bulletin is concerned with the rowing of sheared Douglas-fir Christmas rees in Oregon and Washington. An stimated 80% of these are developed n plantations and the remainder in atural stands. The purpose of shear-ng is to improve shape, taper, and ensity of Christmas trees by cutting ack the leaders and lateral branch ips. Shearing makes production of high uality trees possible on medium timber rowing sites. Until development of uccessful shearing techniques in recent ears, medium sites were considered nsuitable for growing adequately dense hristmas trees. Now we find that edium sites are actually the preferred reas for producing the highest quality heared trees using relatively short otations.

oth sheared and unsheared-type Douglas-ir Christmas trees are produced in regon and Washington. However, shear-ng is a relatively recent development. rior to about 1960, virtually the ntire cut of Douglas-fir was from nsheared stands on the slow-growth tes IV and V. Unsheared trees, stinguished by their natural uncut aders and branch tips, still comprised re than 90% of the Douglas-fir Christmas trees harvested in 1966. Nonetheless, the sheared Douglas-fir appears to be here to stay, and it will undoubtedly continue to capture a growing share of the market.

Some idea of the current market trend for sheared Douglas-fir is indicated by an estimated 500% increase between 1961 and 1966. And still the supply of high quality trees has not caught up with demand. Sheared Douglas-fir has been particularly well received on the California and other Southwest markets which absorb about 70% of the Christmas trees produced in Oregon and Washington. They are also increasingly in demand by those local consumers who prefer a heavy, dense branch structure.

National statistics* for 1964 credit Douglas-fir for 22% of total U.S.A. production. Only Scotch pine, with 27% of U.S.A. production, provided a greater cut.

Douglas-fir is the leading Christmas tree species in Oregon and Washington by a wide margin. Production in 1964**, the latest year reported is tabulated below. Present trends indicate that the"% sheared", which appears in the last column might double by 1969.

Table 1.--Christmas Tree Production - 1964

All Species		Douglas-fir only		
State	No. Trees	No. Trees	% Total Production	% Sheared
Oregon	710,000	410,000	58	11
Washington	2,450,000	2,360,000	96	4
Two-State Total	3,160,000	2,770,000	88	5

*A. M. Sowder, Federal Extension Service, "1964 U.S. Production of Christmas Trees", 1965.

**Bernard S. Douglass, U.S.F.S., "Special Forest Products 1964 Harvesting Report for Oregon and Washington", 1965.

B. DEVELOPING A PLANTATION

1. Site Selection. Plantations should be established in open, well-drained, adequately fertile fields. Typically, they are marginal hill farmlands formerly planted to crops such as grain, berries, hay, and pasture. Lands rated only marginal for other agricultural crops may produce excellent sheared Douglas-fir Christmas trees.

High Site IV, Site III, and Low Site II lands that produce a medium rate of tree growth usually grow better sheared Douglas-fir than either extremely high or extremely low quality sites.

Low Site IV and Site V lands usually produce shearing response too slowly unless fertilizers are applied to stimulate tree growth. High Site II and Site I lands tend to produce excessively rapid, unwieldy growth and heavy suckers and stubs after shearing. Fortunately, a large share of the marginal-type farmlands in western Oregon and western Washington are rated approximately Site III. Your local Farm Forester or Soil Conservation Service Conservationist can help analyze prospective plantation areas for site classification, as well as other characteristics that are important for producing high quality sheared Douglas-fir Christmas trees. Gentle sloping hill land farms, upland benches, or rolling lowland fields may be good prospects.

Poorly drained fields should be avoided. Indicators of poor drainage are standing water during prolonged rainy periods or floods and presence of water plants such as wire grass, sedge, skunk cabbage, buttercup, and wild parsnip.

Frost pockets should also be avoided. Late spring freezing persistently occurs on certain areas, killing back the tender new growth tips. Frost dieback lowers quality and, at the same time, prolongs the rotation. Frost pockets are frequently found in valley bottoms, natural bowls, and extensive flat areas.

Highly productive agricultural soils are not generally desirable for growi sheared Douglas-fir Christmas trees. They are expensive to purchase and ar usually better suited for other inter sively managed crops. Frequent disad vantages of highly productive soils are lush growth of competing grass ar weeds, excessive rodent populations, and frequent association with poor ai drainage and high-water tables.

Some other considerations in selectin a good field for a Douglas-fir planta tion follow:

Preferably level to gently slopi ground. Where slopes are steeper tha about 5%, west side Douglas-fir usual respond best on southerly and wester exposures. Slopes steeper than abou 10% are capable of producing good tr but may cause erosion problems and higher equipment operating costs.

Freedom from heavy infestations Canada thistle, blackberry, quack gr and other hard-to-control competing ground cover.

Lack of competition from adjacen or intermingled larger trees. Shade and root competition causes weak branches and sparse needles, especia when the competing trees occur withi 100-feet south or west from the Christmas trees.

Adequate winter access and tresp control.

2. Recommended Seed Source. Forest geneticists have discovered important growth characteristic differences in Douglas-fir from vari seed sources. These differences are very important insofar as Christmas tree quality is concerned.

West side plantations, where most sheared Douglas-fir Christmas trees are produced, should normally be

planted only with seedlings from west side seed sources. Provenance tests have been made of numerous west side seed sources to select the best sources for growing Christmas trees. These were rated in the following order: Southeastern Vancouver Island; Shelton, Washington; and Corvallis, Oregon.*

A few exceptions to the above recommendations should be noted. Trees from the Corvallis and Vancouver Island seed sources are early bud breakers. This causes them to be quite susceptible to frost damage. The Forks, Washington strain, an unusually late bud breaker, is recommended for planting frost pockets and other areas with reoccurring late spring freezes. Also, that portion of western Oregon south of Roseburg is probably better adapted to local seed sources, which are acclimated to the generally warmer and drier sites found in this area.

Typical needle form of the highest rated southeastern Vancouver Island seed source (right) is compared with the next highest rated Shelton seed source (left).

Favorable east side(of Cascades)sites, as well as west side, are capable of producing high quality sheared Douglas-fir. Best chances for success are where annual leader growth exceeds about 14" such as higher sites in northeastern Washington or irrigated fields. Just as west side seed sources are recommended for west side plantations, east side seed sources (preferably local) are recommended for east side plantations. West side strains simply lack inherited resistance to the climatic extremes of heat, cold, and dryness that are typical of the most east side areas. Rocky Mountain strains, such as from Colorado and New Mexico, are climatically "tough" and produce a moderate growth rate and attractive blue-green needles. These may be worth trying on a small-scale experimental basis by east side growers. However, the mainstay should be local seed sources until trial and error has definitely proved that some other seed source will produce a better Christmas tree.

3. Planting.

Ground Preparation. Newly planted trees have poor survival and stunted growth if there is excessive grass or weed competition. Grass and weeds hurt the trees three ways: They rob moisture and nutrients from the soil; they shade and suppress the seedlings, and they provide a habitat for mice, rabbits, gophers, root weevils, and other tree-eating pests.

Fields should be deeply plowed, disked, and harrowed before planting. Old fields and pastures with heavy sod also require summer fallowing to break down the sod. Some fields contain a heavy growth of Canada thistle, bracken fern, trailing blackberry, or other Atrazine-resistant species. These may be controlled prior to planting by repeated cultivating or with selective herbicides.

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*Bernard S. Douglass, U.S. Forest Service, and Gary H. Sander, Oregon State Extention Service, "Recommended Seed Origins for Douglas-fir,Scotch Pine,and Shore Pine Plantation-Grown Christmas Trees in Western Oregon and Washington", October 14, 1966.

Some fields contain a hard,root-resistant plow pan or hardpan layer just below the plowing depth. In this case, a deep subsoiler or ripper greatly benefits root penetration and tree growth by breaking up the hard layer.

This field is being fall-cultivated in preparation for spring planting. A second disking and harrowing just prior to planting is recommended when soil conditions will permit.

Plantation Design and Layout. Spacing 5'x5' provides 1,740 trees per acre. This is the maximum number of 5½' to 7½' tall trees, the most popular sizes, that can be produced without crowding the roots or crowns. Spacing may be adjusted somewhat if unusually short or tall trees are desired, or if extra wide equipment will be operated between the rows.

Planting in perfect squares (check rows) has the advantage of permitting mowing or cultivating in two directions. It also provides a more pleasing appearance than random spacing within each row. Check rowing may be accomplished by scoring the ground lightly in two directions before planting to mark out a square grid for a guide, or by planting along a wire marked at 5-foot intervals. However, many growers do not believe that the added time and cost o planting in perfect check rows is justified. They prefer, instead, to space the trees randomly in straight rows and rely on chemicals to control grass and weeds.

Well-planned access roads facilitate culturing and harvesting operations. They also serve as firebreaks.

Roadways are needed through the planta tions to provide access and fire prote tion. These can be provided by skippi the planting of two adjacent rows at intervals of every 30 to 40 rows. Weed-and grass-free firebreaks are als recommended around flammable perimeter of the plantation, particularly next t public roads.

Correcting Nutritional Deficiencie Plantation managers should have knowle of nutritional levels of their soil before planting Douglas-fir Christmas trees. Minimum levels of principal nutriments are necessary for good grow For example, shortage of potassium causes winter yellowing and, in extrem cases, needle drop and bud aborting in the lower crown. Shortage of nitrogen causes stunted growth and also yellowi of the needles. Deficiencies are most likely to occur in old fields where continuous past farming has consumed

available nutriments with no provision for replacement.

It will pay most growers to have a soil analysis made to determine the types and quantities of additives that should be worked into the soil before planting. Instructions on soil analysis procedures may be obtained from your County Agent. Be sure to include a statement with the soil samples that the intended use of the land is for growing Douglas-fir Christmas trees. This will enable the soil scientist to relate his analysis to tree farming.

Planting Stock. Seedlings may be purchased from the Dwight L. Phipps Forest Nursery, c/o Oregon State Department of Forestry, Salem, Oregon, or the Mike Webster Forest Nursery, c/o State of Washington Department of Natural Resources, Olympia, Washington. They may also be purchased from several private tree nurseries which specialize in Christmas tree stock. Check with your local forester.

Planting stock should be ordered well in advance of planting and arrangements made for delivery or pickup just prior to planting. Seedlings are packed in waterproof bags or tight bundles at the nursery for convenient shipping. Water should always be poured through open-ended bundles as soon as they arrive to replenish lost moisture. If possible, the seedlings should be stored in a 35° to 40°F. cooler prior to planting. Otherwise, store them outdoors in a cool spot. Unless trees stored outdoors will be planted within about a week after delivery, they should be removed from the bundle and heeled in where there is protection from root drying, direct sunlight, and drying winds.

Some plantation owners have improved survival and growth rate by purchasing 2-1 transplant seedlings, which have developed 2 years in the nursery bed and one year in a transplant bed. Nurseries that handle transplants sell them for about twice the cost of regular 2-year-old seedlings. Transplants can also be developed in home transplant beds from regular 2-year-old seedlings. Detailed instructions for developing 2-1 transplants at home are found in bulletin No. 5* in this series.

Planting Techniques. Planting requires special techniques for good survival. Your local forester should be consulted. Early spring planting is usually more successful than fall planting, especially on heavy soils that are subject to frost heaving.

Small acreages are usually planted by hand, using a shovel or planting bar. One man can usually plant 400 to 800 trees per day. However, time and money may be saved by planting larger areas with a tractor-drawn tree planting machine. It plants about 10 to 20 times faster than a hand planter, and gives excellent survival when good equipment is properly operated on well prepared ground.

Loss of planted trees is greatest during the first year after planting. Survival of up to 99% has been experienced under favorable conditions. On the other hand, survival of less than 50% may occur on severe, soddy, or rodent-infested sites. Retaining some of the smaller sized seedlings in a transplant bed will provide a handy source of planting stock to replace dead trees during the first year or two after establishment of the plantation.

4. Grass and Weed Control.

Chemicals. Effective grass and weed control is the greatest single key to good survival and growth of planted seedlings. Shallow cultivation was, until recent years, the usual method of eliminating grass and weed competition. Today, it has been largely replaced by spraying the ground with chemical grass and weed killers. Atrazine is the most

*Bernard S. Douglass, U.S.F.S., "Cultural Practices for Growing Christmas Trees in the Pacific Northwest", revised June 1967.

effective chemical known at this time for West Coast conditions. It can be applied over the tops of dormant trees without damaging needles or roots. Moreover, it is effective as either a postemergent spray on an existing grass and weed cover or as a pre-emergent spray to prevent future growth of grass or weeds on clean cultivated areas. Atrazine also appears to act similar to fertilizers in stimulating growth and dark green color. Instructions for using Atrazine follow:

Season to Apply. Best results are obtained in February or March. However, fair results may be obtained for pre-emergent spraying as late as April. At least 2" or 3" of rainfall are desirable before the beginning of the growing season.

Atrazine treated plantation (right) is compared with untreated area(left).

Mixing Instructions. The most economical form of Atrazine is a wettable powder, which is mixed with water in the spray tanks. Mechanical or bypass agitators are necessary to prevent the Atrazine from settling out. One gallon of water per pound of Atrazine may be used for aerial applications, while 25 or more gallons of water per pound are recommended for spraying with ground equipment.

Pre-emergent Spraying. The purpose of pre-emergent spraying is to prevent sprouting of grass and weeds on bare ground. This is the most effective wa to use Atrazine. It should be broadca applied directly over the tops of newl planted, dormant trees as soon as possible after planting. Either boom aerial spraying methods are feasible. Recommended application is 3 to 5 poun per acre. Plantations should be resprayed every year or two, as needed

Sprayers can be inexpensive and still be effective.

Post-emergent Spraying. The purpo of post-emergent spraying is to kill existing grass and weeds in establishe plantations. Atrazine is an effective post-emergent, as well as pre-emergent spray. Small trees may be either aerial or boom sprayed, but larger trees require aerial application or narrow-gauge equipment that will work between the rows to avoid mechanical damage to the trees.

Some growers have developed their own narrow-gauge spray equipment to operat between tree rows. They contain a number of low-profile, directed spray jets to give coverage between and unde the trees.

omewhat stronger application rates of trazine--4 to 6 pounds per acre--are equired for postemergent spraying. on't expect effective control with ither pre-emergent or postemergent praying on Atrazine-resistant plants uch as bracken fern, blackberries, anada thistle, Queen Anne lace, and ye grass.

n smaller operations that won't justify urchase or hiring of spray equipment, 3-gallon, swing-bale garden sprinkling an can be used to do a satisfactory ob of either pre-emergent or post-mergent grass and weed control. nstructions for this procedure follow

ix one tablespoon of Atrazine per allon of water in the sprinkling can. ipping the can during use will keep he Atrazine in suspension. Three allons will cover approximately 300 quare feet of ground or provide a -foot diameter treated circle around bout 40 individual trees.

Cultivating. Although largely eplaced by chemicals, cultivation still as a place for grass and weed control. onventional tractors and cultivators ay be used when trees are small enough or the tractor to ride above their ops without causing damage. When the rees exceed this height, narrow-gauge, hallow-digging, rotary types are ecommended that will operate between he rows. Situations that favor ultivation include:

(1) Controlling Atrazine-resistant grass and weed species.

(2) Aerating compacted, cracked clay-type soils.

Mowing is effective for controlling Arazine-resistant weeds or grass. I benefits the trees by eliminating sade on the lower branches, reducing fre hazard, and removing the rodent hbitat. It is also used where a low vgetative cover is desired to control eosion or prevent muddy harvesting cnditions.

Narrow, low-profile rotary mowers are recommended. They shred grass and weeds into small particles, thus reducing its fire hazard and hastening its decay. However, sickle bar mowers may be necessary to cut extremely heavy weed or grass covers that rotary types won't handle. Deflectors should be installed on the mowing equipment to prevent accidental damage to lower branches.

5. Pre-Shearing Care. The grower's main concern during the first year or two after planting is to keep his trees alive, healthy, and growing. Grass and weed control have been described in the previous section. In addition, the following jobs are necessary:

Protect the seedlings from damage by fire, rodents, deer, and livestock. Fire trails, fencing, or baiting may be necessary.

Replace dead, dying, or sickly seedlings with healthy stock for the first year or two after planting. Thereafter, replanted seedlings would be unlikely to catch up with the rest of the plantation. Some growers solve this problem by developing table-sized trees for later replacements by means of early, tight shearing.

Multiple leaders should be cut flush with the stem as soon as they appear.

Remove all multiple leaders except one by cutting them flush with the main stem. The single retained leader should be selected on a basis of size, vigor, straightness, and number of buds.

If the terminal bud dies or a leader is broken off at its base, a new leader will likely develop from a turned-up branch of the top whorl. However, multiple leaders tend to develop. This can be corrected by cutting back the tips of all the branches in the top whorl except the one selected to form a new leader.

Occasionally an entire tree will suffer major damage from freezing, heavy grazing, vandalism, or running over by equipment.

Young Douglas-firs have a remarkable ability to recover from such damage if more than about 10% of their original live branches survive. The established root systems enable the damaged trees to form new sprouts. These will often produce a Christmas tree quicker than a replanted seedling.

6. Basal Pruning. Basal pruning is the removal of unwanted lower branches between the bottom of the Christmas tree and the ground. It should form a reasonably straight handle of at least 1" per foot of tree height. Basal pruning should be sufficiently high to avoid serious defects such as incomplete bottom whorls and crooked handles. The branches should be cut flush with the stem to avoid both stubs and heavy scars. Short, heavy machetes and hand pruners are commonly used tools for basal pruning.

Basal pruning is one of the standard practices to develop high quality sheared Douglas-fir in plantations. The selected bottom whorl should contain 5 or more well distributed, vigorous branches just above the handle. It ma be located only 10" to 15" above the ground in well cared for plantations where grass and weeds are effectively controlled by chemicals, cultivation, or mowing. Where grass and weeds are not effectively controlled, the bottom whorl should be located above the leve of heavy shade.

High basal pruning unnecessarily prolongs the rotation period required to grow marketable trees. It also makes shearing more difficult

A vigorous cluster, or rosette, of int nodal branches, as well as a main noda whorl, will form an acceptable bottom whorl on a plantation-grown Douglas-fi This may save a year's growing time over selecting a nodal whorl higher on the stem.

When to start basal pruning is importa If done when the tree is too small, it may shock the tree and appreciably stu next year's growth*. If postponed too long, it may require the cutting of heavy, dense branches and raise prunin costs. Basal pruning too late may als

*Bernard S. Douglass, U.S.F.S., in cooperation with the Oregon and Washington Extension Service, Oregon State Forestry Department, and State of Washington Department of Natural Resources, "Leader Growth Control Studies for Douglas-fir Christmas Trees", April 1, 1964.

allow insufficient time for the handle to heal over smoothly and the bottom whorl branches to overcome a suppressed appearance on their undersides.

A happy medium would be to defer basal pruning until the tree has attained sufficient size that pruned limbs will not exceed about 25% of the total foliage. On Site III plantations, this stage of development frequently occurs after the 3rd or 4th growing season when the trees are 4' to 5' tall. Site IV plantations would normally be basal pruned one year later than Site III plantations. Basal pruning is frequently done the year after shearing is begun.

7. Shearing. Shearing involves cutting back leaders and lateral branches to perfect the cone shape, control the percent taper (width of a tree expressed as a percentage of its height), and increase density. Douglas-fir responds better to shearing than any other fir species grown in the Pacific Northwest.

This tree is receiving its first shearing after developing a leader longer than 20". However, basal pruning should be deferred one more year to prevent overshock.

Year to Start. Many growers start shearing too soon for best results. Premature shearing unnecessarily lengthens the time for a tree to attain merchantable height. It may also cause excessively stubby, dense crowns.

The best time to start shearing on medium site plantations is after the 2nd or 3rd growing season when trees are 3' or 4' tall and leaders longer than 20" first develop.

An exception would be on poorer sites where leaders lack sufficient vigor to attain 20" lengths by the 4th growing season after planting, but where crowns still need shearing to improve shape and density. In this case, shearing should begin 2 to 4 years before harvest, or whenever trees develop excessive lateral growth or leaders become too long to fill in adequately with internodal branches.

Time of Year. Douglas-fir has a long shearing season. It begins in August, when buds on the new growth are first readily visible, and extends into the following spring until the buds first start to open. July shearing is not generally recommended because it may stimulate late summer regrowth sprouts, called lammas growth. Resulting irregular, excessively long branch tips frequently require reshearing to restore good proportion.

Exception to the long shearing season is the final shearing before harvest. At this time, August and September are the preferred months. Late summer shearing allows sufficient time before the cutting season for the sheared stubs to callous over.

Tools. Shearing knives and hedge shears are the most popular shearing tools. Either tool in experienced hands will produce professional quality shearing.

Most effective knife shearing is accomplished by long, sweeping downstrokes with a thin, sharp shearing knife 14" to 18" long. Leg protectors are strongly recommended for safety; and also leaving of two rows of trees between personnel in the shearing crew to prevent knife accidents.

A shearer is expertly shaping trees in a 4-year-old plantation. He strives for a narrow, uniform cone-shape between the sheared leader tip and bottom whorl.

Hedge shears are usually held upside down to make the angle of the blades conform with the contour of the tree. The tree is clipped from the top downward using a series of quick strokes. Although not as fast as shearing knives, hedge shears are much safer to use.

Power clippers, both electric and gasoline motor operated, are used to a limited extent for shearing. They may come into much greater future use with technological improvements and the current trend toward mechanization.

Every person should carry hand pruners while shearing. They are handy for removing suckers and multiple leaders, trimming top whorls and leaders, and correcting in-pointing branches and other defects. Double-edged hand prun are the recommended type. They do not bruise-cut branches as badly as the single-edged anvil types.

Techniques. Some growers shear th leaders and top whorls with a hand pruner as a separate operation from th side shearing. Others shear both the leaders and natural branches with a shearing knife, hedge shears, or power clippers as a single operation. Basic techniques are the same either way. The leader is cut back at a 45^{o} slant, leaving an internodal bud about 1/4" below the high point of the cut. The top bud forms next year's leaders and the internodal buds below it develop into lateral branches.

Many growers preshear the leader and top whorl as a separate operation from side shearing. This permits better control in making each cut above a good internodal bud.

At the same time the leader is pruned, the tips of the lateral branches of th top whorl must be pruned back to resto good proportion and prevent them from turning up to form multiple leaders. Ideally, the cut should be made just

above an internodal bud on the lower side of the branch or two opposite side buds. Leaving a bud on the top side of a sheared branch tip results in an unsightly, in-pointing branch.

Finally the tree is side sheared. Side shearing establishes the taper between the top of the sheared leader and the bottom whorl of the tree. A perfectly uniform cone-shape produces the best results. Taper should be quite narrow (about 50%) for intermediate shearings, and increased to about 60% for the final shearing before harvest. This widening permits very light, skillful finish-shearing. Resulting appearance is natural and stub free.

Once started, shearing must be continued each year until the tree is harvested. After three or four shearings, trees lose their appearance of having distinct whorls because growth of internodal branches is stimulated and fills in the internodal spaces.

Leader Straightening. Next year's leaders, arising from the top buds of a pruned leader, do not always grow straight and erect. They may form a noticeable offset, called a "dogleg" where the top bud turns upward to form a new leader. These conditions should not cause alarm prior to the harvest year because bent or crooked leaders tend to either straighten themselves or become hidden by new growth. However, they may cause noticeable defects on trees ready for harvest unless corrective action is taken.

A wire straightener is the best method to correct an existing bent or doglegged leader. Best season to train leaders is late July and early August when new growth has sufficiently hardened off to resist injury by the wire. The wired leaders will set permanently after about 30 days, and should then be removed. An effective method of applying a wire straightener is to make a loose spiral around the bent leader with a 12" to 16" piece of aluminum wire. This permits bending and holding the leader to a vertical position. Light leaders can be trained by #13 gauge electric fence wire, but a heavier wire (up to #9 gauge) may be required to straighten heavy, stiff leaders.

The best way to prevent, or at least minimize, bent and doglegged leaders is to shear them during the late succulent stage in July or early August. This causes the top bud to become more erect and better adjusted to form a vertical leader. Early leader shearing sometimes encourages the top bud to develop a short sprout of regrowth, called "lammas growth" during late summer. When this occurs, the tip of the new sprout normally contains a perfect rosette of buds for next year's top whorl. However, the new sprout may have to be sacrificed by reshearing if it creates an excessively long leader.

Leader pruning in late summer is permitting the top bud to grow more erect. This reduces its tendency to form a bent leader or noticeable "dogleg".

Comparative Shearing Experiments. Shearing studies were started in Oregon and Washington in 1964 to evaluate and compare eight different sheared leader length combinations when the crowns were sheared to a 50% taper. They have shed some new light on this new and important cultural practice for Pacific Northwest growers.

This beautiful stand of medium density trees was produced in only 5 growing seasons by the progressive leader shortening method of shearing. About a third of the trees are now ready to cut. The remainder will be harvested in the next two years.

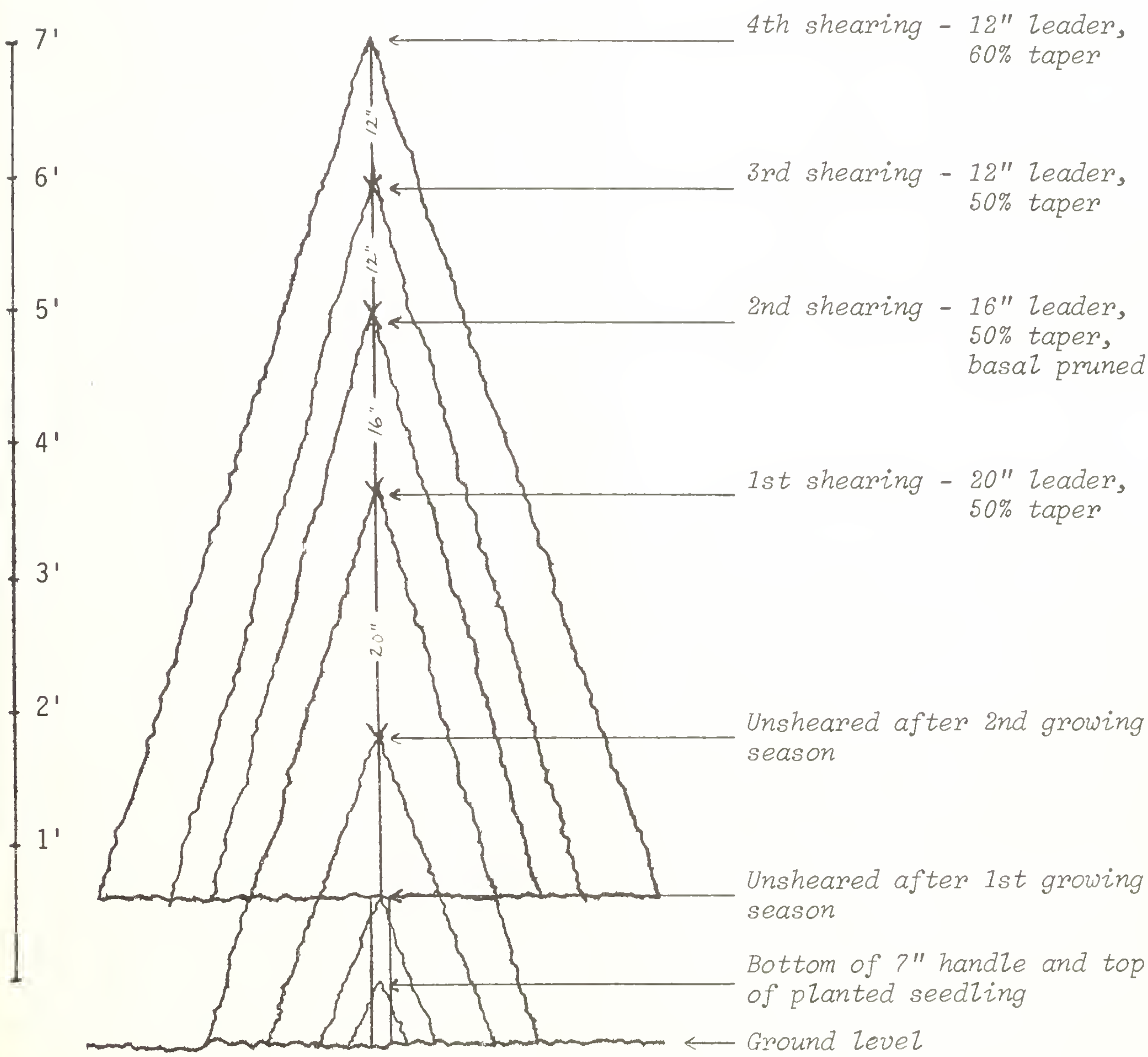
The experiments were conducted on two medium growth rate, Site III, plantations which are generally considered best for producing medium to densely sheared Douglas-firs. To date, one method seems to have produced better results than any of the others from the combined standpoints of quality control, cultural cost savings, and shortest possible rotation period. It consists of progressively shortening the leaders each year, from 20" the 1st year, to 16" the second year, to 12" the 3rd year, and about 12" every year thereafter until the tree is ready to harvest. Shearing is begun when the tree first develops a leader more than 20" long. Four or five consecutive shearings normally produced high quality 6' to 7½ trees in five to seven growing seasons after planting in the field. The principle of progressive leader shorten ing is to maintain relatively wide inte nodal spacing near the base of the crow where several years of growth can be anticipated to fill in the open spaces before harvesting. At the same time, progressively shorter internodal spacin is maintained toward the top of the tre to develop adequate bushiness in that area.

The diagram on page 13 shows theoretica development for a 7-foot sheared Dougla fir Christmas tree by the progressive leader shortening method.

The above leader lengths serve only a guideline, not an inflexible rule. For example, exceptionally well-budded leaders might be cut a few inches longe than the suggested lengths, and still produce sufficient density of internoda branches to fill in the crown. On the other hand, sparsely-budded leaders might need to be cut several inches shorter to produce adequate crown densi

These shearing studies were made on Site III plantations, which produce a medium growth rate. Modifications of the 20", to 16", to 12" rule would likel be needed on slow growth rate Sites IV and V. Here, the crowns would normally have insufficient vigor to produce 20" leaders before reaching Christmas tree size unless the trees are fertilized to stimulate growth. However, they may still produce 15" to 20" long leaders, which are too long for high quality unsheared trees. Trees growing in Sites IV and V plantations may also for excessively wide lateral branches. The solution to both these growth problems is to start shearing to form a 50% cone 2 to 4 years before harvesting dependin on when excessive leader growth or exce sively wide taper first becomes a problem. Leaders might be progressivel shortened from, say, 16" the first year

Development of a 7-foot Sheared Douglas-fir in 6 Growing Seasons by the Progressive Leader Shortening Method



of shearing to 10" or 12" during the last shearing before harvesting. The more times a tree is sheared and the shorter its leader is cut, the heavier its density becomes.

8. Year by Year Cultural Schedule from Planting Until Harvest.

These instructions assume that sheared Douglas-fir will be developed on a Site III plantation.

After 1st Growing Season. During the first year, concentrate mainly on keeping the trees alive and vigorous.

The only required first year's pruning would be removing occasional multiple leaders and suckers. Select the best multiple leader on a basis of vigor, erectness, and bud set. Cut all others flush with the main stem.

Grass and Weed Control. Atrazine applied immediately after planting will usually remain effective through the first summer. Reapply Atrazine during the following February or March if grass and weeds reappear.

Cultivating is usually unnecessary with Atrazine. Exceptions might be to retain moisture in heavy, cracked clay soils, or to control a heavy cover of Atrazine-resistant grass and weed species.

Replace any dead trees during the next regular planting season. Replacements made after this year would unlikely catch up with the other trees in time for harvest.

After 2nd Growing Season. A few of the fastest growing trees might produce leaders longer than 20". These are now ready for their first shearing. Cut the leaders back to 20". At the same time, shear the side branches to form a near-perfect 50% tapered cone between the sheared top of the leader and the bottom whorl of branches.

Continue Atrazine spraying or cultivation if competing vegetation is, or threatens to become, a problem.

After 3rd Growing Season. Once it is started, a tree must be sheared eac year until ready to harvest. Progressively reduce its sheared leader lengt each year using the 20" to 16" to 12" rule. For example, if a tree had its leader cut back to 20" last year, cut it back to 16" this year, and 12" next year, and every year thereafter. Continue to shear the side branches to form a 50% cone.

Continue Atrazine spraying as needed. Aerial application is usually the most economical method when trees are too tall for tractor clearance.

Basal prune to form a clean handle not less than 9" long, whenever so doing will not remove more than 25% of the total foliage.

After 4th Growing Season. Continu shearing and basal pruning as previous described. Trees sheared for the 3rd time should have their leaders cut bac to 12"; those sheared the 2nd time to 16"; and those sheared the first time 20". In-pointing branches, suckers, a other defects should be removed at the time of shearing.

Continue Atrazine spraying. Mow betwe the rows to remove bracken fern, Canad thistle, and other Atrazine-resistant species.

After the 5th Growing Season. Most trees are not yet ready to harvest. Continue shearing these as previously described.

However, few trees will likely be read to harvest this year after only 4 consecutive shearings. Carefully fini shear them as follows:

Cut the leader in proportion to the re of the crown to form a sheared cone. Usually about a 12" leader will accomplish proper proportion.

Side shear very lightly to form a perf cone. Light shearing will increase th percent taper from about 50% for previ shearings to about 60%. This widening

will eliminate most of the visible stubs.

After the 6th and 7th Growing Seasons. Continue the same cultural treatments described above for the 5th growing season. Most growers will plan to harvest all remaining marketable type trees after the 7th growing season.

Site IV lands will likely require 8- or 9-year rotations instead of 7, unless fertilizers are used to stimulate growth rate.

9. Planning the Next Crop. A Douglas-fir plantation is normally harvested over a 3- or 4-year period. The stumps and cull trees are then plowed or bulldozed out and burned, the ground leveled, cultivated, and a new plantation of seedlings established.

Exceptions to clearcutting are sometimes practiced. For example, stump culturing may be desirable to preserve an unusually desirable and hard-to-replace seed source or a grafted plantation of elite trees. Or it may be desirable to establish an uneven-aged or mixed-species stand for a "Choose-and-Cut" operation. This can be accomplished by annually planting a new tree beside the stump of every tree that is harvested, or perhaps by combining this method with stump culturing.

But, by and large, most growers prefer to start over with a new even-aged plantation. Stump cultures sometimes die or do not shape up well into a second tree. At best, they require heavy, intensive basal pruning for good results. Moreover, a plantation tends to gradually become infested with atrazine-resistant species. These are difficult to eradicate without clean cultivating or broadcast application of a sterilizer-type herbicide.

C. DEVELOPING A NATURAL STAND

1. Site Selection. Although most sheared Douglas-firs are now produced in plantations, high quality trees are also developed in natural stands. Some growers are beginning to develop both sheared and unsheared trees in the same natural stand on lower sites. This is a good practice because shearing salvages many fast-growing or poorly shaped trees that could not otherwise be sold. It also provides a wider selection of trees for the market.

Shearing would not benefit this slow-growing tree. Its natural shape and density is already adequate. Moreover, it would respond too slowly to shearing. Better management would be to harvest it as an unsheared tree after spring fertilizing to improve needle color, and branch stiffness.

Medium quality sites (Low II, III, and High IV) are recommended for sheared Douglas-fir wildlings, the same as for plantation-grown sheared Douglas-firs. Extremely slow growth or fast-growth sites may cause problems. For example, low Site IV and Site V lands produce such slow growth that internodal branches, main lateral branches, and leaders do not recover and "fill in" quickly after shearing. Most trees on these lower quality sites will develop quite well without shearing.

An exception to this rule would be when growth rate is artificially stimulated by fertilizing. This, in effect, raises the site and may cause excessively wide-spaced whorls unless the trees are sheared.

On the other extreme, high Site II and Site I naturally stocked lands frequently produce growth that is too coarse and rapid for good shearing response. Also, hardwood trees, brush, bracken ferns, and other vegetative competition growth quite rank on high quality sites and are difficult and costly to control.

Natural areas suitable for shearing should be adequately stocked with reproduction 3' to 8' in height. Lack of excessive amounts of tall fern, competing hardwoods, and unwanted coniferous species are a great cost advantage in culturing. Consider also the advantages of gentle terrain, a good road system, lack of severe fire hazard, and effective trespass control.

2. Thinning and Hardwood Control. The following treatments are the first ones required to develop a sheared natural stand. These are no different than those used to develop unsheared trees in a natural stand.

Remove hardwood trees and brush. Control stump sprouting by spraying freshly cut surfaces with brush killer herbicides.

Remove larger Douglas-firs (except possibly 1 or 2 high-pruned seed trees per acre) and also hemlock, cedar, and other unwanted coniferous species.

Space-thin the remaining Douglas-firs, striving for an average spacing of about 5 feet. Somewhat closer spacing may be utilized where there is sufficient spread of heights to prevent crowding.

3. Basal Pruning. Basal pruning of natural stands is usually started at the same time that they are thinned. Benefits and techniques of basal pruning are essentially the same as those previously described for plantations. The selected bottom whorl should contain at least 4 or 5 well distribut vigorous branches in a main nodal whor It is usually necessary to locate it t two feet or more above the ground to develop an adequate bottom whorl above the level of heavy brush, fern, tall weeds, and other shade producing grour cover.

In order to prevent overshock to the tree, basal pruning should be deferrec until the tree has attained sufficient size that pruned limbs will not exceec about 25% of the total foliage. Some growers avoid overshock by basal pruning in stages over a period of severa years. The first stage should always begin at the bottom whorl and progres downward on the stem as far as the above "25% rule" will permit. This i followed by one or more follow-up prunings to remove the remaining unwanted branches when the tree has attained sufficient size and vigor to resist overshock.

4. Shearing. Shearing technique for natural-grown Douglas-fir are qui similar to those already described fo the plantation-grown trees. In fact, a customer buying a sheared Douglas-f might have difficulty knowing whether it was cut in a plantation or natural area. However, there are some differences in the way sheared natura and sheared plantations are managed.

Natural trees take several years long to develop than plantation trees, eve when site quality is the same on both areas. This is due in part to growth retardation during early stages of development caused by competition of brush, ferns, and tall weeds commonly associated with natural stands. Natural trees also take several additional years to develop a bottom whor above the shade level of this ground competition. Since high crowns are relatively difficult to reach with shearing tools, the bottom whorl shou be located as close to the ground as possible without causing it to be suppressed.

Two general types ot sheared trees are produced on natural areas:

(1) Heavy to medium density trees are usually produced on fast to medium growth areas such as Site II and Site III. They can also be produced on Site IV lands where growth rate has been artificially stimulated for two years or longer by fertilizing. Three to five consecutive shearings are normally required to produce high quality trees. Shearing by the progressive leader shortening method,as previously described for developing plantation-grown trees, is recommended. Resulting appearance is very similar to plantation-grown trees.

(2) Light density trees are usually produced on medium to slow growth areas, such as Site III, Site IV, and even Site V if growth has been stimulated for two years or longer by fertilizing. Only **2 or** 3 consecutive shearings are normally required to produce marketable quality.

Two successive light shearings have improved shape and density of this natural tree but have not eliminated the natural openings between whorls which many buyers prefer.

Pointed out is where an excessively long leader was sheared last year on a cultured natural tree. A new leader developed from a single internodal bud left 1/4" below the cut. At the same time, a false whorl developed from a cluster of internodal buds 3" below the cut.

Shearing techniques are different from those used to develop heavily sheared trees. The purpose of light shearing is to narrow the taper, perfect the cone-shape, and increase the density, but still preserve some degree of natural internodal spacing between the whorls. This is accomplished by maintaining an annual leader length of 10" to 14", the same as for unsheared trees. Concurrently with cutting back the leaders, the tips of the main lateral branches are sheared back to form a perfect cone-shape. Considerable potential exists for lightly sheared trees in the southern Puget Sound area, where production of unsheared, cultured natural trees has been centered for many years.

5. Fertilizing with Nitrogen. Fertilizing natural stands of Christmas trees with nitrogen is a relatively new, but increasingly important cultural aid. It is used to improve the color, luster, size and retention of needles; and to increase the growth rate, stiffness, and vigor of leaders and branches. A bulletin published by the Washington State University Cooperative Extension Service provides detailed information on this subject.* Some highlights from this reference follow:

Slow growth Sites V, IV, and Low III, such as those found in Kitsap and Mason Counties in Washington, are most likely to benefit from nitrogen. Trees growing on these relatively infertile, dry sites frequently have light, yellowish needles and weak branches.

If the objective of fertilizing is to improve both needle appearance and growth rate, nitrogen should be applied in March or April, 3 or 4 years before harvest. If the objective of fertilizing is to improve the needles without increasing growth rate, nitrogen should be applied during the bud swelling season in about May of the same year that the tree will be harvested. A delayed-action growth stimulation occurs during the second growing season after application. This usually necessitates correctional leader shearing and side shearing whenever the leader growth exceeds about 14".

Straight nitrogen fertilizers, such as urea (46% nitrogen), ammonium nitrate (33% nitrogen) and ammonium sulphate (21% nitrogen) have usually proven to be more economical and just as effective as balanced fertilizers. Individual tree application, unlike broadcast application, permits varying the amount of fertilizer and time of application to suit the needs of individual trees. Granular type fertilizer is preferred because it is easy to spread under the dripline of the trees by hand or with a back-pack machine blower.

This canvas back-pack carrier was designed especially for applying granulated fertilizer. It is easier to handle than a bucket, and reduces spillage.

Amount of nitrogen per tree should be determined by trial and error for the least quantity that will do the desir job of needle improvement or growth stimulation. Suggested trial rates a 1/16 pound to 1/4 pound (actual nitro weight) per 6' tree. Experiments on low site lands in Kitsap County, Wash ton, indicate that 1/8 pound of nitro per tree will not increase growth app ably the first growing season after application, but will increase it abo 75% for several growing seasons there after.

Use of nitrogen increases the necessi and desirability of shearing. In eff it raises the site quality of land on which it is applied. Prior to using fertilizer, an area may produce leade only 12" long. These may suddenly increase to 18" on trees which were n cut the same year that they were fertilized.

*Darrell O. Turner and Joseph Buhaly, Wash. St. University, "Fertilizing Natural Douglas-fir Christmas Trees", Extension Bulletin #585, May 1966.

ne grower is then faced with two alternatives. He can either sacrifice the ree by thinning it out as a cull or he an develop high quality by shearing. ncreasing numbers of growers are finding that shearing is the most profitable olution.

6. Planning for a Continuous Crop. ne following practices are used to help nsure a sustained yield of trees year fter year on cultured natural areas.

Stump Culture. Stump culture is ne practice of developing a new hristmas tree from a small limb or prout left on the stump after a hristmas tree has been cut. It should e considered where there is an inadequate stocking of natural seedlings to eplace trees that are cut. To make his system work, a cluster or whorl f branches, making up not less than 0% of the total foliage of the tree, hould be left on the stem near the round and below the handle. This oliage should be lopped back to about ne-half of its original length when he tree is cut to stimulate vertical prouts. A year or two after the tree s cut, the most promising multiple prout is selected to form a new tree, nd all the others are removed. Competing leaders and branches are gradually emoved as the sprout begins to form a ew tree. Some growers have produced or 4 successive Christmas trees from a single stump.

esults are relatively poor where stump ulture utilizes an upturned branch nstead of a sprout. Whorl development n a branch is likely to be incomplete or many years. The resulting tree ill not readily develop symmetric shape. f a limb does eventually form a ymmetric crown, it is likely to be too igh above the ground for easy shearing.

Seed Trees. Many growers retain ne or two older trees per acre for eed production to insure a perpetual rop of new seedlings. A common mistake s leaving an excessive number of seed rees per acre. They compete with the understory Christmas trees and appreciably lower production per acre as well as quality.

Seed trees should be full crowned, healthy, and good Christmas tree form to increase the probability that seedlings will inherit desirable characteristics. Trees should be left in pairs or small groups where possible to facilitate cross pollinization of cones. They should be pruned high to reduce shading of Christmas trees, but not more than 1/3 of their live crowns should be removed. Viable seed production usually starts when the tree is about 30 years old.

Spot Planting. Where seed trees are lacking or, for some reason, do not provide an adequate stocking of natural seedlings, unstocked spots should be hand planted. Planted seedlings should be spaced about five feet apart. Hardwood thickets sometimes form canopies too dense for survival of seedlings. They should be cut, and stump-sprayed with a herbicide to prevent sprouting before planting is attempted. Commonly used tools for spot planting on natural areas are planting hoes and planting bars.

Developing a Two-Story Stand. When trees are basal pruned several feet above the ground, adequate space is often provided to start natural seedlings under their canopies. These will have a head start when the overstory Christmas trees are harvested and frequently develop into a replacement more quickly and with less work, than by developing a stump culture. Trees with the best natural Christmas tree form should be selected for replacements, and others thinned to provide adequate spacing.

Harvesting as a Method of Thinning. Harvesting should provide adequate thinning for adjacent trees, as well as remove trees that are ready to market. Trees standing alone and not touching or shading other trees can be left a year or two longer than usual to develop 8', 9', and 10' sizes.

However, those that are crowded should be thinned to provide adequate growing space on all sides of those that are retained. Ideally, this thinning should be accomplished by harvesting the surplus trees for market. These provide a good source of supply for the 3', 4', and 5' sizes. Unfortunately, many trees that need immediate thinning are not of sufficient quality to market. In this case it is better to sacrifice the poorer trees by thinning than to spoil the future quality of all the trees by leaving the area overstocked.

D. PROTECTION

Protection from damage by animals, insects, diseases, fire, and trespass are covered in detail in the following publications:

"Raising Christmas Trees for Profit", Knut Lunnum, Cooperative Extension Service, Washington State University, Revision 1968.

"Cultural Practices for Growing Christmas Trees in the Pacific Northwest", Bernard S. Douglass, U.S. Forest Service, Region 6, Portland, Oregon, June 1967.

"Diseases and Insects of Christmas Tree Plantings", Arthur Partridge, Otis C. Maloy, John A. Schenk, and David H. Brannon, Extension Mimeograph 2604, Washington State University Extension Service, Revision January 1967.

"Pests and Disease Control Guide for Christmas Trees", C. S. Davis, E. E. Gilden, C. S. Koehler, and A. H. McCain, Pub. AXT-130 University of California Extension Service, Revision January 1965.

"Wildlife Feeding Injuries on Conifers in the Pacific Northwest", William Laurence, Nelson B. Kverno, and Harry D. Hartwell, distributed by Western Forestry and Conservation Association, Portland, Oregon, June 1961.

E. HARVESTING AND MARKETING

Refer to the following bulletin:

"Christmas Tree Harvesting and M keting for Pacific Northwest Growers Bernard S. Douglass, U. S. Forest Se Region 6, Portland, Oregon, October

F. SOURCES OF ASSISTANCE AND INFORM

Services of a farm forester are avai to most woodland areas in Oregon and Washington. The office address of t local farm forester can be obtained inquiring at any State Forestry Depa ment Office in Oregon or State Depar ment of Natural Resources Office in Washington.

Reference material is available from the County Extension Agent. He can also advise growers concerning the availability of assistance from farm foresters, extension foresters and others who work with Christmas tree growers.

Additional sources of Christmas tree culturing information are:

Extension Forestry Specialist
Cooperative Extension Service
205 Forestry Building
Oregon State University
Corvallis, Oregon 97331

Extension Forestry Specialist
Cooperative Extension Service
Washington State University
Johnson Hall 317-A
Pullman, Washington 99163

Extension Forestry Specialist
Cooperative Extension Service
Western Washington Research and Extension Center
Puyallup, Washington 98371

Local offices of the Soil Conservation Service

ecial Products Forester
vision of State and Private Forestry
S. Forest Service
O. Box 3623
rtland, Oregon 97208

rthwest Christmas Tree Association
he name and address of the current
cretary may be obtained by contacting
y of the mentioned sources of informa-
on).

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

PACIFIC NORTHWEST REGION—STATE AND PRIVATE FORESTRY

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DEVELOPMENT OF SHEARED DOUGLAS-FIR CHRISTMAS TREES

CONTENTS

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FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

DEVELOPMENT OF SHEARED DOUGLAS-FIR CHRISTMAS TREES

A. INTRODUCTION

This publication describes the procedures for growing high quality sheared Douglas-fir Christmas trees in Oregon and Washington. It updates the original edition, printed in November 1967, and includes new techniques developed since that date by growers, experimenters, and scientists.

The purpose of shearing is to improve shape, aper, and density of Christmas trees by cutting back the leaders and lateral branch tips. Shearing is always necessary to develop quality production on the faster tree-growing areas (Site III and better). It is also finding increased application, ogether with fertilizing, on slower tree-growing reas (Sites IV and V) that formerly produced nly unsheared trees.

Prior to about 1960, virtually the entire cut of Douglas-fir was from unsheared stands on slow ree-growth areas (Sites IV and V). By 1970, heared trees accounted for approximately one-ourth of the total Douglas-fir cut. An estimated 5 percent of these sheared trees were developed n plantations and the remainder in natural tands. The trend toward sheared trees is sharply pward, as indicated in Table 1.[1]

able 1.—Sheared Douglas-fir Christmas Tree Production in Oregon and Washington, 1959-69

Year	Total Douglas-fir Harvested	Percent Sheared
1959	3,040,000	1
1964	2,770,000	5
1969	2,420,000	22

heared Douglas-fir have been particularly well eceived on the California and other Southwest arkets, which absorb about two-thirds of all hristmas trees produced in Oregon and Washington. They are also increasingly in demand by ocal consumers.

Latest national statistics[2] credit Douglas-fir with 22 percent of the total United States Christmas tree production. Only Scotch pine, with 27 percent, provided a greater nation-wide cut. Douglas-fir is the leading Christmas tree species in Oregon and Washington by a wide margin. It accounted for 83 percent of the total harvest in 1969.

B. DEVELOPING A PLANTATION

1. Site Selection. — Plantations should be established on open well-drained adequately fertile fields. Typically such fields are located on hillside farms, upland benches, or rolling lowlands formerly planted to agricultural crops such as grain, berries, hay, and pasture. Lands rated only marginal for other agricultural crops may produce excellent sheared Douglas-fir Christmas trees.

High Site IV, Site III, and Low Site II lands that produce a medium rate of tree-growth are usually better suited for sheared Douglas-fir than either extremely high or extremely low quality sites.

Low Site IV and Site V lands usually produce a shearing response which is too slow unless fertilizers are applied to stimulate tree growth. High Site II and Site I lands tend to produce excessively rapid, unwieldy growth with heavy suckers and stubs after shearing. Fortunately, a large share of the marginal-type farmlands in western Oregon and western Washington are rated medium site. Your local Farm Forester, Extension Agent, or Soil Conservation Service representative can help analyze prospective plantation areas for site classification, as well as other characteristics that are important for producing high quality sheared Douglas-fir Christmas trees.

Poorly drained fields should be avoided. Indicators of poor drainage are standing water during prolonged rainy periods or floods and presence of water plants such as wire grass, sedge, skunk cabbage, buttercup, and wild parsnip.

[1] Bernard S. Douglass, U.S. Forest Service, "Special orest Products Harvesting Reports for Oregon and Washgton," 1959, 1964, and 1969.

[2] A. M. Sowder, Federal Extension Service, "1964 U.S. Production of Christmas Trees," 1965.

Frost pockets should be avoided whenever possible. Late spring freezing persistently occurs on certain areas and will damage or kill the tender new growth tips. Frost dieback lowers quality and, at the same time, prolongs the rotation. Frost pockets are frequently found in valley bottoms, natural bowls, and extensive flat areas.

Highly productive bottomland agricultural soils are not generally the best choice for growing sheared Douglas-fir Christmas trees. They are expensive to purchase and are usually better suited for other intensively managed crops. Disadvantages of such sites are lush growth of competing grass and weeds, excessive rodent populations, and frequent association with poor air drainage and high-water tables.

Preferred areas are level to gently sloping. Where sustained slopes are steeper than about 5 percent, west side Douglas-fir usually responds best on southerly and westerly exposures. Slopes steeper than about 10 percent are also capable of producing good trees but may cause erosion problems and higher equipment operating costs.

Avoid areas with heavy infestations of Canada thistle, blackberry, quack grass, and other hard-to-control competing ground cover. Several years of costly chemical applications or prolonged cultivation may be required to eliminate these species which compete with and retard planted Douglas-fir seedlings.

Extremely sandy soils deficient in organic matter may produce good tree growth, but are difficult to treat with herbicides and fertilizers. These chemicals leach into such soils very rapidly and may cause serious damage to tree roots.

Avoid competition from larger trees. Shade and root competition causes weak branches and sparse needles, especially when the competing trees are within 100 feet south or west of the Christmas trees.

Consider adequate winter access and trespass control.

2. Recommended Seed Sources. — Forest geneticists have discovered important growth characteristic differences in Douglas-fir from various seed sources. These differences are critical insofar as Christmas tree quality is concerned.

West side plantations, where most sheared Douglas-fir Christmas trees are produced, should b[e] planted only with seedlings from west side see[d] sources. Provenance tests have been made of numerous west side seed sources to select the bes[t] strains for growing Christmas trees. The Shelton Washington, and southeastern Vancouver Islan[d] sources were highly rated.[3]

Earliness of bud-bursting is an important consideration where frost or Douglas-fir needle midg[e] damage occurs. Early bud-bursting strains suc[h] as southern Willamette Valley and southeaster[n] Vancouver Island are relatively susceptible t[o] frost and midge damage. An unusually late bu[d] bursting strain, such as Forks, Washington, ma[y] be a good prospect where late frosts occur. Th[e] popular Shelton, Washington, strain is rated a[s] moderately late in bud-bursting time.

That portion of western Oregon south of Roseburg is probably best adapted to local seed source[s] which are acclimated to the generally warmer an[d] drier sites found in this area. By the same token it would be unsafe to use this seed source in th[e] Willamette Valley or Puget Sound Basin.

[3] Bernard S. Douglass, U.S. Forest Service, and Gary H Sander, Oregon State Extension Service, "Recommende[d] Seed Origins for Douglas-fir, Scotch Pine, and Shore Pin[e] Plantation-Grown Christmas Trees in Western Oregon an[d] Washington," October 14, 1966.

Typical needle form of two highly rated seed sources. Southeastern Vancouver Island (right) and Shelton, Washington, (left) seed sources are compared.

Although most sheared Douglas-fir sites are found west of the Cascade Summit, a few suitable sites also occur east of the Cascades. One example is the higher site areas in northeastern Washington where annual leader growth exceeds about 14 inches. Another example is where irrigation is used to artificially improve growth rate. Just as west side seed sources are recommended for west side plantations, east side seed sources (preferably local) are recommended for east side plantations. West side strains lack inherited resistance to the climatic extremes of heat, cold, and dryness that are typical of east side areas. Rocky Mountain strains, such as from Colorado, Arizona, and New Mexico, are climatically "tough" and produce a moderate growth rate and attractive blue-green needles. These may be worth trying on a small-scale experimental basis by east-side growers. However, local seed sources should be their mainstay until trial and error have definitely proved that some other seed source will produce a better Christmas tree.

3. Planting. —

Ground Preparation.—Newly planted trees ıave poor survival and stunted growth if there is ;xcessive grass or weed competition. Grass and veeds hurt the trees four ways: they rob moisture ınd nutrients from the soil; they shade and sup-›ress the seedlings; they create a fire hazard; ınd they provide a habitat for mice, rabbits, go-›hers, root weevils, and other tree-eating pests.

ʼields should be deeply plowed, disked, and har-ʼowed before planting. Old fields and pastures vith heavy sod also require summer fallowing to ›reak down the sod. Some fields contain a heavy ;rowth of Canada thistle, bracken fern, trailing ›lackberry, or other hard-to-kill atrazine-resist-nt species. These may be controlled prior to ›lanting by repeated cultivation or with selective erbicides. Some fields contain a hard, root-resist-nt plow pan or hardpan layer just below the ormal plowing depth. In this case, a subsoiler or xtra deep plowing greatly benefits root penetra-ion and tree growth by breaking up the hard ıyer.

)uack grass is a special problem in some fields.)eep plowing is not recommended because it does ot kill the roots, but only buries them too deep or easy eradication. A better solution is spraying it with amino-triozole when the grass is 3 to 4 inches high, then harrowing out the roots after about 3 weeks when the grass blades turn white.

This field is being fall-cultivated in preparation for spring planting. A final disking and harrowing is recommended just prior to planting.

Plantation Design and Layout. — Recommended spacing is 5½ by 5½ feet for developing trees 6½ to 7½ feet tall, which are the most popular sizes. This spacing provides about 1,300 trees per acre, after deducting 10 percent of the full stocking for an adequate road system. Spacing may be adjusted somewhat if unusually narrow, wide, short, or tall trees are desired.

Table 2.—

Spacing in Feet	TREES PER ACRE	
	Planted Solid	10% Reduction for Roads
4½′ × 4½′	2,151	1,936
5′ × 5′	1,742	1,568
5½′ × 5½′	1,440	1,296
6′ × 6′	1,210	1,089
6½′ × 6½′	1,031	928

Planting in perfect squares (check rows) has the advantage of permitting mowing or cultivating in two directions. It also provides a more pleasing appearance than random spacing within each row. To make check rows, score the ground lightly in two directions before planting to mark out a square grid as a guide, or plant along a wire marked at desired intervals. However, many growers do not believe that the added time and cost of planting in check rows is justified. They prefer, instead, to space the trees randomly in straight rows and rely on chemicals to control grass and weeds.

Well-planned access roads facilitate culturing and harvesting operations. They also serve as firebreaks.

Roadways are needed through the plantations to provide access and fire protection. These can be provided by skipping the planting of two adjacent rows at intervals of every 20 to 40 rows.

Weed- and grass-free firebreaks are also recommended around flammable perimeters of the plantation, particularly next to public roads.

Correcting Nutritional Deficiencies.—Plantation managers should have knowledge of nutritional levels of their soil before planting Douglas-fir Christmas trees. Minimum levels of principal nutriments (nitrogen, phosphorus, potash, magnesium, and sulphur) are necessary for good growth. For example, shortage of potassium causes winter yellowing and, in extreme cases, needle drop and bud aborting in the lower crown. Shortage of nitrogen causes stunted growth and also yellowing of the needles. Deficiences are most likely to occur in fields where continuous past farming has consumed available nutriments with no provision for replacement.

It will pay most growers to have a soil analysis made to determine the types and quantities of additives that should be worked into the soil before planting. Instructions on soil analysis procedures may be obtained from your Extension Agent. Be sure to include a statement with the soil samples that the intended use of the land is for growing Douglas-fir Christmas trees. This will enable the soil scientist to relate his analysis to tree farming.

The grower should plan to keep the plantation growing vigorously in subsequent years, using fertilizer as required. Tree growth rate and color are the best indicators of whether additional fertilizer is necessary for the years following planting.

Planting Stock.— Seedlings from a number of identified seed sources may be purchased from the Dwight L. Phipps Forest Nursery, Oregon State Forestry Department, Salem, Oregon; or the Mike Webster Forest Nursery, State of Washington Department of Natural Resources, Olympia, Washington. They may also be purchased from several private tree nurseries which specialize in Christmas tree stock. Farm Foresters and Extension Agents can provide additional information on nurseries and tree ordering procedures.

Planting stock should be ordered well in advance of planting and arrangements made for delivery or pickup just prior to planting. Seedlings are packed in waterproof bags or tight bundles at the nursery for convenient shipping. Water should always be poured through open-ended bundles as soon as they arrive to replenish lost moisture. If trees are not planted within about 2 weeks after delivery, they should be stored in a 35° F. cooler or heeled in where there is protection from root drying, direct sunlight, and drying winds. Temporary storage should be outdoors in a cool (but not freezing), shaded spot.

Some growers have improved survival and growth rate by purchasing 1-1 or 2-1 transplant stock which have developed 1 or 2 years in the nursery

bed and an additional year in a transplant bed. Nurseries that handle transplants sell them for about twice the cost of regular 2-year-old seedlings. Transplants can also be developed in home transplant beds from regular 2-year-old seedlings.

Planting Techniques. — Skillful planting techniques are required for adequate survival. Early spring planting is usually more successful than fall planting, especially on heavy soils that are subject to frost heaving.

Small acreages are usually planted by hand, using a shovel or planting bar. One man can plant about 400 to 800 trees per day. However, time and money may be saved by planting larger areas with a tractor-drawn tree planting machine. A single-row planting machine can plant 5,000 to 10,000 trees per day. Excellent survival can be achieved when good equipment is properly operated on well prepared ground.

Loss of planted trees is greatest during the first year after planting. Survival of up to 99 percent has been experienced under favorable conditions. On the other hand, survival of less than 50 percent may occur under unfavorable conditions. Retaining some of the seedlings in a transplant bed will provide a handy source of planting stock to replace dead trees during the first year or two after establishment of the plantation.

Atrazine treated plantation (left) is compared with untreated area (right).

4. Grass and Weed Control. —

Chemicals.—Effective grass and weed control is the greatest single key to good survival and growth of planted seedlings. Shallow cultivation was, until recent years, the only method of eliminating grass and weed competition. Today, it has been largely replaced by spraying the ground with chemical grass and weed killers known as "herbicides." Atrazine is the most effective herbicide known at this time for West Coast conditions. It can be applied over the tops of dormant trees without damaging needles or roots. Moreover, it is effective as either a *post-emergent spray* on existing grass and weeds or as a *pre-emergent spray* to prevent future growth of grass or weeds on clean cultivated areas. Atrazine also breaks down chemically and acts as a fertilizer in stimulating growth and color. Instructions for using atrazine follow:

Season to Apply.—Best results from both pre-emergent and post-emergent spraying are obtained in February or March. However, fair results may be obtained for pre-emergent spraying as late as April on newly planted areas. At least 2 or 3 inches of rainfall are desirable between the time of application and the beginning of the growing season.

Mixing Instructions.—Atrazine is a wetable powder which is mixed with water in the spray tanks. Mechanical or by-pass agitators in the spray tanks are necessary to prevent the atrazine from settling out. As little as 1 gallon of water per pound of atrazine may be used for aerial applications, while 10 or more gallons of water per pound are recommended for spraying with ground equipment.

Pre-emergent Spraying.— The purpose of pre-emergent spraying is to prevent sprouting of grass and weeds on bare ground. This is the most effective way to use atrazine. It should be broadcast-applied directly over the tops of newly-planted, dormant trees as soon as possible after planting. Either tractor-operated boom spraying or aerial spraying methods are feasible. Usual application rate is 4 to 6 pounds per acre. However, up to double this rate may be used where live roots of quack grass or other resistant species are mixed in the soil. A spreader-sticker added to the spray will improve its effectiveness. Plantations

usually require respraying every year in February or March for good grass and weed control. However, the application rate of atrazine is sometimes cut down to about 2 or 3 pounds per acre where past applications have eliminated most of the competing vegetation.

Sprayers can be inexpensive and still be effective.

Post-emergent Spraying. — The purpose of post-emergent spraying is to kill existing grass and weeds in established plantations. Atrazine is an effective post-emergent, as well as pre-emergent, spray. Small trees may be either aerial or boom sprayed, but larger trees require aerial application or narrow-gauge equipment that will work between the rows to avoid mechanical damage to trees.

Some growers have developed their own narrow-gauge spray equipment to operate between tree rows. These contain a number of low-profile spray jets to give coverage between and under the trees.

Application rates of 4 to 6 pounds per acre are adequate for controlling many grass and weed species. Up to double this amount may be required to control partially atrazine-resistant species such as perennial rye grass, quack grass, alta fescue grass, and Queen Anne's lace. Certain weeds such as bracken fern, blackberries, false dandelion, and Canada thistle are almost totally resistant to atrazine. These species should be controlled with a carefully-directed spray of other chemicals. Amino-triozole, for example, is effective for controlling Canada thistle and bracken fern. Low volatile ester of 245T is effective for controlling blackberries and Scotch broom.

On smaller plantations or home transplant beds that won't justify purchase or hiring of spray equipment, a 3-gallon sprinkling can may be used to do a satisfactory spray job. Instructions for this procedure follow:

Thoroughly mix 1 tablespoon of atrazine per gallon of water in the sprinkling can. Normal tipping of the can during use will keep the atrazine in suspension. Three gallons will cover approximately 300 square feet of ground or provide a 3-foot diameter treated circle around about 40 individual trees.

Cultivating.—Although largely replaced by chemicals, cultivation still has a place for grass and weed control. Conventional tractors and cultivators may be used when trees are small enough for the tractor to straddle their tops without causing damage. Larger trees require narrow-gauge, shallow-digging, rotary types that can be operated between the rows. Situations that favor cultivation include:

a. Controlling atrazine-resistant grass and weed species.

b. Mulching compacted, cracked, clay-type soils to conserve moisture.

Mowing.—Unlike cultivation or chemicals, which are intended to kill competing vegetation, mowing merely controls the height of such vegetation. Like cultivation or chemicals, it benefits the trees by eliminating shade on the lower branches, preventing entwined blackberry vines and other vegetation in the lower crowns, conserving soil moisture, reducing fire hazard, and removing the rodent habitat. It also facilitates moving about between the rows and working around the bases of the trees during such cultural operations as shearing, basal pruning, and spraying. Mowing is sometimes actually preferred to bare ground conditions during the last few years before harvesting where a low vegetative cover is desired to control erosion or to prevent muddy harvesting conditions.

Narrow, low-profile rotary or hammer-type mowers are recommended. They shred grass and weeds into small particles, thus reducing their fire hazard and hastening their decay. However, sickle bar mowers may be necessary to cut extremely heavy grass or weeds that rotary types won't handle.

5. Pre-Shearing Care. — The grower's main concern during the first year or two after planting is to keep his trees alive, healthy, and growing rapidly. Grass and weed control has been described. The following additional jobs are also necessary:

a. Protect the seedlings from damage by fire, deer, livestock, and rodents. Fire trails, mowing, fencing, or baiting may be necessary.

b. Replace dead, dying, or sickly seedlings with healthy stock within 1 or 2 years after the initial planting. Thereafter, replanted seedlings would not be marketable at the same time as the rest of the plantation. Some growers develop table-sized trees from the later replacements by means of early, tight shearing.

c. Remove all multiple leaders except one by cutting them flush with the main stem. The single retained leader should be selected on a basis of size, vigor, straightness, and number of buds.

Multiple leaders should be cut flush with the stem as soon as they appear.

d. If the terminal bud dies or a leader is broken off at its base, a new leader will likely develop from a turned-up branch of the top whorl. However, multiple leaders tend to develop in this case. This can be corrected by cutting back the tips of all the branches in the top whorl except the one selected to form a new leader.

e. Occasionally an entire tree will suffer major damage from freezing, heavy grazing, vandalism, or equipment. Young Douglas-firs have a remarkable ability to recover from such damage if more than about 20 percent of their original live branches survive. The established root systems enable the damaged trees to form new sprouts. These will often produce a Christmas tree quicker than a replanted seedling.

6. Basal Pruning. — Basal pruning is the removal of unwanted lower branches between the bottom of the Christmas tree and the ground. It should form a reasonably straight handle of at least 1 inch per foot of tree height. Basal pruning should be sufficiently high to avoid serious defects such as incomplete bottom whorls and crooked handles. The branches should be cut flush with the stem to avoid both stubs and heavy scars. A hand pruner is the most common basal pruning tool used when trees are young and small-branched. Older, large-branched trees may require use of a saw or a short, heavy machete.

Basal pruning is one of the standard practices to develop high quality sheared Douglas-fir in plantations. The selected bottom whorl should contain five or more well distributed, vigorous branches just above the handle. It may be located only 8 to 15 inches above the ground in well cared for plantations where grass and weeds are effectively controlled by chemicals, cultivation, or mowing. Where grass and weeds are not effectively controlled, the bottom whorl should be located above the level of heavy shade.

A cluster, or rosette, of internodal branches, although somewhat less desirable than a main nodal

Unnecessarily high basal pruning prolongs the rotation period required to grow marketable sheared trees. It also makes shearing more difficult.

branch whorl, will develop into an acceptable bottom whorl on a plantation-grown Douglas-fir. In practice, internodal branches are more frequently chosen for the bottom whorl than a natural node. This may save a year's growing time over selecting a main branch whorl higher on the stem. It also helps to keep the crown sufficiently low for easy reach in shearing.

The proper time to start basal pruning is important. If done when the tree is too small, it may cause shock and appreciably stunt next year's growth.[4] If postponed too long, it may require the cutting of heavy, dense branches and raise pruning costs. Basal pruning too late may also allow insufficient time for the handle to heal over smoothly and the bottom whorl branches to overcome a suppressed appearance on their undersides.

A happy medium would be to defer basal pruning until the tree has attained sufficient size that pruned limbs will not exceed about 25 percent of the total foliage. For most trees on medium growth plantations (Site III), this stage of development occurs after the third growing season when the trees are about 3½ to 4½ feet tall. Lower site plantations would normally be basal pruned 1 year later than Site III plantations. Basal pruning is frequently done either the same year or the year after shearing is begun.

7. Shearing. — Shearing involves cutting back leaders and lateral branches to perfect the cone shape, control the percent taper (width of a tree expressed as a percentage of its height), and increase the density. Douglas-fir responds better to shearing than any other fir species grown in the Pacific Northwest.

This tree is receiving its first shearing. Basal pruning will be deferred 1 more year to prevent overshock.

Year to Start. — The usual time to start shearing on medium site plantations is after the second or third growing season when trees are about 3½ to 4½ feet tall and leaders 20 inches or longer first develop. Not all trees develop at the same rate. Therefore, the faster developing trees might attain shearable size after only 2 growing seasons, but the balance of the stand may not be ready to start shearing until the following year.

Exception to this general rule on when to start shearing would be on poorer sites where leaders lack sufficient vigor to attain 20-inch lengths by the third growing season after planting, but where crowns still need shearing to improve shape

[4] Bernard S. Douglass, U.S. Forest Service, in cooperation with the Oregon and Washington Extension Service, Oregon State Forestry Department, and State of Washington Department of Natural Resources, "Leader Growth Control Studies for Douglas-fir Christmas Trees," April 1, 1964.

and density. In this case, shearing should begin 3 or 4 years before harvest, or whenever trees develop excessive lateral growth and leaders become too long to fill in adequately with internodal branches.

Time of Year.—Douglas-fir has a long shearing season. It begins in late July when buds on the new growth are visible, and extends into the following spring until the buds start to open. Early season shearing sometimes stimulates late summer regrowth sprouts, called *lammas growth*, especially when summer rains occur. Resulting irregular, excessively long branch tips may require touching up to restore good proportion during the year of harvest.

An exception to the long shearing season is the final shearing before harvest. For this, July, August, September, and October are the preferred months. Late summer or early fall shearing allows sufficient time for the sheared stubs to callous over before the cutting season.

Tools.—Shearing knives, hedge shears, and power clippers are effective shearing tools. Any of these tools in experienced hands will produce professional quality shearing.

Knife shearing is presently the most popular method. It is accomplished by long, sweeping downstrokes with a thin, sharp knife 14 to 16 inches long. Leg protectors are strongly recommended for safety when using knives. Another safety measure is leaving two rows of trees between personnel in the shearing crew. Right-handed shearers should work counterclockwise around each tree to keep their left leg clear of the knife strokes.

A shearer is expertly knife-shaping trees in a 3-year-old plantation. He strives for a narrow, uniform cone-shape between the sheared leader and bottom whorl.

Hedge shears are usually held upside down to make the angle of the blades conform with the contour of the tree. The tree is clipped from the top downward using a series of quick strokes. Hedge shears are not as efficient as shearing knives, but are safer to use and provide less strain on the operator.

Light-weight clippers powered by electric or gasoline motors are used to a limited extent for shearing. Both rotary knife and sickle bar types are available. They may come into much greater future use with technological improvements and the current trend toward mechanization.

Every person should carry hand pruners while shearing. They are handy for removing suckers and multiple leaders, trimming top whorls and leaders, and correcting in-pointing branches and other defects.

Techniques.—Some growers shear the leaders and top whorls with a hand pruner as a separate operation from the side shearing. Others shear both the leaders and lateral branches as a single operation. Basic techniques are the same either way. The leader is cut back to at least one-fourth inch above an internodal bud to prevent dieback of the bud. The top bud forms next year's leader and internodal buds below it develop into lateral branches.

At the same time the leader is pruned, the tips of the lateral branches of the top whorl must be pruned back to restore good proportion and prevent them from turning up to form multiple leaders. Ideally, the cut should be made just above an internodal bud on the lower side of the branch or two opposite side buds. Any bud occurring on the top side of a sheared branch tip should be picked off to prevent its forming an unsightly, in-pointing branch.

Next, the tree is side sheared. Side shearing establishes the shape and percent taper between the top of the sheared leader and the bottom whorl of

Many growers preshear the leader and top whorl with a hand pruner as a separate operation from side shearing. This permits better control in correcting defective tops and in cutting individual branches to exact desired lengths.

This tree will be shaped by cutting back the branch tips in the final shearing before harvesting. Uniform density and shape give it good prospects to grade "U.S. Premium."

the tree. Percent taper means the width of the crown expressed as a percentage of its height. The desired shape is a uniform, near-perfect cone shape. Taper should be quite narrow (about 50 percent) for intermediate shearings, and increased to about 60 percent for the final shearing before harvest. This final widening permits very light, skillful finish-shearing. Resulting appearance is natural and stub free.

Once started, shearing must be continued each year until the tree is harvested. After three or four shearings, trees lose their appearance of having distinct whorls because the stimulated growth of internodal branches fills in the internodal spaces.

Leader Straightening.—Next year's leader, arising from the top bud of a pruned leader, does not always grow straight and erect. It may have a noticeable offset, called a "dogleg," where the top bud turns upward to form a new leader. This condition should not cause alarm prior to the harvest year because bent or crooked leaders often tend to either straighten themselves or become hidden by new growth. However, they may cause noticeable top defects on trees ready for harvest unless corrective action is taken at the time the trees receive their final or "finish" shearing.

A simple but effective method for correcting a typical doglegged leader is to bind it tightly against a 2-inch-long leader stub left for this purpose. A couple of wraps with plastic ribbon is useful for tying the leader in an upright position against the stub. Sometimes a doglegged leader is too rigid and coarse to straighten. In this case, it should be cut off and a flexible internodal branch below it tied to a vertical position by the same method. This procedure may also be used for replacing a leader too high on the tree for good proportion and density, or for replacing a leader sprout broken off near the top of the leader by birds or wind during its succulent growth. One way to prevent, or at least minimize, bent and doglegged leaders is to shear them during the late succulent stage in July or early August. This causes the top bud to become more erect and better adjusted to form a vertical leader. However, most growers find it difficult to accomplish all of their shearing during such a short season and, instead, rely on correcting doglegs after they have formed.

Replacing Undesirable Leaders.—Some trees develop unusually vigorous leader growth a year or two before they attain harvest size. Such leaders are frequently abnormally large in diameter

ınd very sparsely budded for a foot or more ıbove their bases. Cutting them back in the usual nanner to a 12-inch stub, for example, causes ›roblems.

The scarcity of buds on the leader stub results in ın open "hole" in the upper crown of the tree. A 'urther and even more serious problem is that the 'ew buds that do occur on this heavy leader stub ıbsorb a great deal of growth energy and develop nto large, coarse, doglegged multiple leaders alled "deerhorns." This problem, once it starts, ›erpetuates itself each year until it is corrected.

'he "deerhorn" problem can be prevented or corected by completely removing the large leader or eerhorn. Then a flexible internodal branch about inches below the cut is bent upward and bound rmly against the 2-inch leader stub with two or hree wraps of plastic ribbon. Lastly, the upurned internodal branch is cut back to proper ength and forms a new leader. Unlike the natural eader, it is usually well-budded and sufficiently mall not to form abnormal top growth during he following growing season. Cutting back the ırge natural leader actually enhances the development of the tree by directing growth energy ıto the lower portion of the crown.

Comparative Shearing Experiments.—Shearing studies were initiated in Oregon and Washington in 1964 to evaluate and compare eight different sheared leader length combinations when the crowns were sheared to a 50 percent taper. These studies have demonstrated the effectiveness of an advanced shearing technique for Pacific Northwest growers.

The experiments were conducted on two medium growth rate plantations, one near Corvallis, Oregon, and the other near Olympia, Washington. Both areas were considered well adapted for production of sheared Douglas-firs. One of the methods tried produced better results than any of the others from the standpoints of tree quality and shortness of rotation. It consisted of progressively shortening the leaders each year, from 20 inches the first year, to 16 inches the second year, to 12 inches the third year, and about 12 inches every year thereafter until the tree was ready to harvest. Shearing is begun 2 or 3 years after planting when the tree first develops a leader more than about 20 inches long. Four or five consecutive shearings normally produced high quality trees 6 to 7½ feet tall in 5 to 7 growing seasons after planting in the field. The principle of progressive

The picture on the left shows coarse, sparsely-budded multiple leaders known as "deerhorns." These need correcting to prevent future openings and deformities in the top portion of the crown. The picture on the right shows the same tree after corrective top shearing with a hand pruner. Note that the harp-shaped multiple top was pruned off just below the fork, together with the two internodal branches nearest to the fork. Pointed out is where an internodal branch was tied vertically against the leader stub to form a new leader.

This beautiful stand of sheared Douglas-fir was produced in only 5 growing seasons by the progressive leader shortening method of shearing. About one-third of the trees are now ready to cut. The remainder will be harvested in the next 2 years.

leader shortening is to maintain relatively wide internodal spacing near the base of the crown where several years of growth can be anticipated to fill in the open spaces. At the same time, progressively shorter internodal spacing is maintained toward the top of the tree to develop adequate bushiness.

The described progressive leader shortening schedule is intended to serve only as a guideline, not an inflexible rule. For example, exceptionally well-budded leaders might be cut several inches longer than the suggested lengths, and still produce sufficient density of internodal branches to fill in the crown. On the other hand, sparsely-budded leaders might need to be cut somewhat shorter to produce adequate crown density.

The above described shearing studies were made on Site III plantations, which produce a medium growth rate. Modifications of the 20- to 16- to 12-inch rule would likely be needed on slow growth rate Sites IV and V. Here, the crowns would normally have insufficient vigor to produce 20-inch leaders before reaching Christmas tree size unless the trees are fertilized to stimulate growth. However, they may still produce 15- to 20-inch long leaders, which are too long for high quality unsheared trees. Trees growing in Sites IV and V plantations may also form excessively wide lateral branches. The solution to both these growth problems is to start shearing to form a 50 percent cone 3 to 4 years before harvesting, depending on when excessive leader growth or excessively wide taper first becomes a problem. Leaders might be progressively shortened, for example, from 16 inches the first year of shearing to 10 inches during the last shearing before harvesting. A good rule of thumb is that the more times a tree is sheared and the shorter its leader is cut, the heavier its density becomes.

8. Year-by-Year Cultural Schedule from Planting Until Harvest. — These instructions assume that sheared Douglas-fir will be developed on a Site III plantation.

After First Growing Season.—During the first year, concentrate mainly on keeping the trees alive and vigorous.
The only required first year's pruning would be removing occasional multiple leaders and suckers. Select the best multiple leaders on a basis of vigor, erectness, and bud set. Cut all others flush with the main stem.

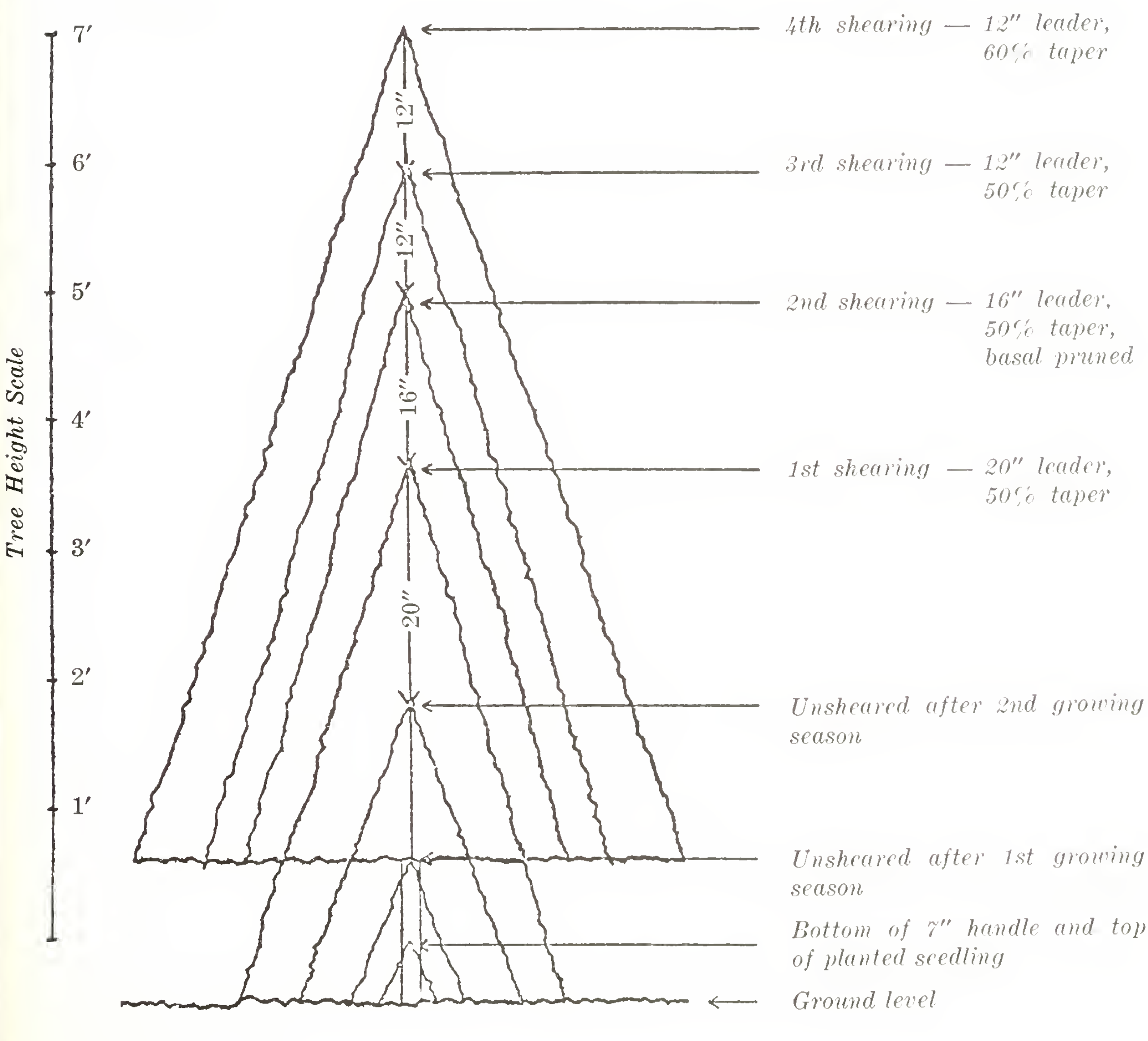
Grass and Weed Control.— Atrazine applied immediately after planting will usually remain effective through the first summer. Reapply atrazine during the following February or March.

Cultivating is usually unnecessary with atrazine. Exceptions might be to retain moisture in heavy, cracked clay soils, or to control a heavy cover of atrazine-resistant grass and weed species.

Replace any dead trees during the next regular planting season. Replacements made after this year would be unlikely to catch up with the other trees in time for harvest.

After Second Growing Season.—Some of the fastest growing trees might produce leaders longer than 20 inches. These are now ready for their first shearing. Cut them back to about 20 inches. At the same time, shear the side branches to form a near-perfect 50 percent tapered cone between the sheared top of the leader and the bottom whorl of branches.

Development of a 7-foot Sheared Douglas-Fir in 6 Growing Seasons by the Progressive Leader Shortening Method



Continue atrazine spraying or cultivation if competing vegetation is, or threatens to become, a problem.

After Third Growing Season.—Once shearing is started, a tree must be sheared each year until ready to harvest. Progressively reduce its sheared leader length each year using the 20- to 16- to 12-inch rule as a guide. For example, if a tree had its leader cut back to about 20 inches last year, cut it back to about 16 inches this year. Continue to shear the side branches to form a 50 percent cone.

Continue atrazine spraying as needed. Aerial application is the usual method when trees are too tall to straddle with a tractor.

Basal prune to form a clean handle when this will not remove more than about 25 percent of the total foliage.

After Fourth Growing Season. — Continue shearing and basal pruning as previously described. Trees sheared for the third time should have their leaders cut back to about 12 inches; those sheared the second time to about 16 inches; and those sheared the first time to about 20 inches. In-pointing branches, suckers, and other defects should be removed at the time of shearing.

Continue atrazine spraying. Mow, till, or use a directed spray between the rows to control bracken fern, Canada thistle, trailing blackberry, wild carrot, perennial rye grass, orchard grass, and other atrazine-resistant weeds and grasses.

After the Fifth Growing Season.—Most trees are not yet ready to harvest. Continue shearing these as previously described.

However, a few trees will likely be ready to harvest this year after only four consecutive shearings. Carefully finish-shear them in late summer or early fall, as follows:

a. Cut the leader in proportion to the rest of the crown to form a sheared cone. Usually about an 8- to 12-inch leader will accomplish proper proportion.

b. Side shear lightly to form a near perfect cone. Shearing lightly will increase the percent taper from about 50 percent for previous shearings to about 60 percent for the last shearing. This widening will eliminate most of the visible stubs.

After the Sixth and Seventh Growing Seasons.—Continue the same cultural treatments described for the fifth growing season. Most growers should plan to harvest all remaining marketable trees after the seventh growing season. Any leftovers that do not shape up properly should be sold at a reduced rate or discarded.

Site IV lands will likely require 8- or 9-year rotations instead of 7, unless fertilizers are used to stimulate growth.

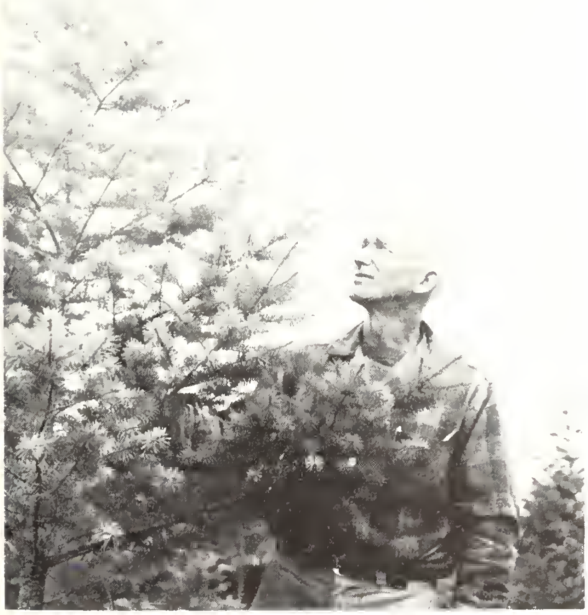
9. Planning the Next Crop.—A Douglas-fir plantation is normally harvested over a 3- or 4-year period. Cull trees are removed and all stumps cut flush with the ground. The grower has a choice of removing the stumps by bulldozing, plowing, disking, or rototilling. Bulldozing removes the whole stumps which are piled for burning. Plowing requires special heavy plows pulled with a large crawler tractor to do an effective job. A portion of the stumps are buried beneath the planting depth, leaving others on or just under the surface. These can be windrowed with a spring-toothed cultivator. Disking, too, requires special heavy equipment pulled with a large crawler tractor. Two diskings are normally required. This procedure breaks up most of the roots and stumps and mulches the soil to a depth of 12 inches or more. Large chunks are removed as previously described. Another successful method uses a heavy duty rototiller which shreds most of the stumps and roots after several passes.

In a few situations, stump removal is not practiced. For example, stump culturing may be a good method to preserve an unusually desirable and hard-to-replace seed source or a grafted plantation of elite trees. Or it may be desirable to establish an uneven-aged or mixed-species stand for a "Choose-and-Cut" operation. This can be accomplished by annually planting a new tree beside the stump of every tree that is harvested, or perhaps by combining this method with stump culturing.

Most growers, however, find it most economical to start over with a new even-aged plantation. An added incentive to this practice is the opportunity to eradicate atrazine-resistant plants, which tend to gradually invade old plantations. These are easier to control by clean cultivation or broadcast application of a sterilizer-type herbicide prior to the next planting.

C. DEVELOPING A NATURAL STAND

1. Site Selection. — Although most sheared Douglas-fir are now produced in plantations, sheared trees are also being developed in natural stands. Some growers are beginning to convert unsheared Christmas tree stands to sheared stands by gradually removing the high pruned overstory and shearing trees at a lower level. Other growers manage and produce both sheared and unsheared trees on the same area by shearing those trees that do not shape up naturally. Natural stands have been successfully sheared over a wide range of sites. Medium sites (Low II, III and High IV) are usually recommended for sheared Douglas-fir wildings. However, Low Site IV and Site V lands are also suitable, but only if nitrogen fertilizer is used. Without added nitrogen, growth is too slow after shearing. Fertilizing, in effect, raises the site and artificially stimulates growth rate and vigor to a degree where good density and shape may be attained by shearing.



Shearing would probably not benefit this slow-growing tree. Its natural shape, height, and density is already adequate. Better management would be to harvest it as an unsheared tree after spring fertilizing to improve needle color and branch stiffness.

On the other extreme, High Site II and Site I naturally stocked lands frequently produce growth that is too coarse and rapid for good shearing response. Also, hardwood trees, brush, bracken ferns, and other competing plants grow quite rank and are difficult and costly to control.

Natural areas suitable for shearing should be adequately stocked with reproduction 3 to 6 feet in height. Excessive amounts of tall fern, competing hardwoods, and unwanted coniferous species greatly increase the cost of culturing. Consider also the advantages of gentle terrain, a good road system, lack of severe fire hazard, and effective trespass control.

2. Thinning and Hardwood Control. — The following treatments are the first ones required to develop a sheared natural stand. These differ very little from those used to develop unsheared trees in a natural stand.

a. Remove hardwood trees and brush. Control stump sprouting by spraying freshly cut surfaces with brush killer herbicides.

b. Remove larger overstory Douglas-fir (except possibly one or two high-pruned seed trees per acre) and also hemlock, cedar, and other unwanted coniferous species.

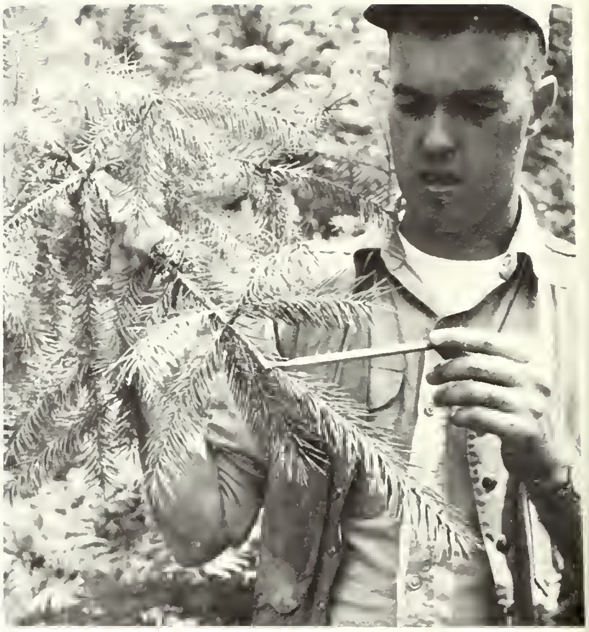
c. Space-thin the smaller Douglas-fir, striving for an average spacing of about 5 feet. Somewhat closer spacing may be utilized where there is sufficient spread of heights to prevent crowding both at present and within the next few years while the overstory is developing. Save only those trees with the highest Christmas tree potential and bottom whorls not higher than about 2 feet above the ground.

3. Basal Pruning. — Basal pruning of natural stands is usually started at the same time that they are thinned. Benefits and techniques of basal pruning are essentially the same as those previously described for plantations. The selected bottom whorl should contain at least four or five well distributed vigorous branches in a *main nodal whorl*. It is desirable to locate it as near to the ground as possible to facilitate easy reach for shearing the tree. However, the basal whorl should be located above any heavy ground cover that cannot be cut back or eliminated.

In order to prevent overshock to the tree, basal pruning should be deferred until the tree has attained sufficient size that pruned limbs will not exceed about 25 percent of the total foliage. Some growers avoid overshock by basal pruning in stages over a period of several years. The first stage should always begin at the selected bottom whorl and progress downward on the stem as far as the above "25 percent rule" will permit.

4. Shearing. — Shearing techniques for natural-grown Douglas-fir are quite similar to those already described for the plantation-grown trees. In fact, a customer buying a sheared Douglas-fir might have difficulty knowing whether it was cut in a plantation or natural area. However, there are some differences in the way sheared natural stands and sheared plantations are managed.

Natural trees take several years longer to develop than plantation trees, even when site quality is the same on both areas. This is due in part to growth retardation during early stages of development caused by competition of brush, ferns, and tall weeds commonly associated with natural stands. Natural trees also take several additional years to develop a bottom whorl above the shade level of this ground competition. Since high crowns are relatively difficult to reach with shearing tools, the bottom whorl should be located as close to the ground as possible without causing it to be suppressed.



Pointed out is where an excessively long leader was sheared last year on a cultured natural tree. A new leader developed from a single internodal bud left one-fourth inch below the cut. At the same time, a false whorl developed from a cluster of internodal buds 3 inches below the cut.

Two successive light shearings have created this marketable, light density tree. The visible internodal openings between whorls are desired by many consumers for hanging pendulant-type ornaments.

Two general types of sheared trees are produced on natural areas:

a. Heavy to medium density trees are usually produced on fast to medium growth areas such as Site II and Site III. They can also be produced on Site IV lands where growth rate has been artificially stimulated for 2 years or longer by fertilizing. Four or five consecutive shearings are normally required to produce high quality trees. Shearing by a progressive leader shortening method, but with shorter leader lengths than previously described for developing plantation-grown trees, is recommended. Also recommended is leaving a 2-inch leader stub above the top bud to bind and train the new leader to a vertical position.

b. Lighter density trees are usually produced on medium to slow growth areas, such as Site III, Site IV, and even Site V if growth

has been stimulated for 2 years or longer by fertilizing. Only two or three consecutive light shearings are normally required to produce marketable quality.

Shearing techniques for creating light density sheared trees in natural stands are different from those used to develop heavily sheared trees. The purpose of light shearing is to narrow the taper, perfect the cone-shape, and increase the density, but still preserve a visible degree of natural internodal spacing between the whorls. This is accomplished by maintaining an annual leader length of 10 to 14 inches, the same as for unsheared trees. Concurrently with cutting back the leaders, the tips of the main lateral branches are sheared back lightly to form a near-perfect cone-shape. Resulting taper is wider—usually 60 to 80 percent—than for heavier sheared trees.

Considerable potential exists for growing lightly sheared trees in the southern Puget Sound area, where production of unsheared, cultured natural trees has been centered for many years.

5. Fertilizing with Nitrogen. — Fertilizing natural stands of Christmas trees with nitrogen is an increasingly important cultural aid. It is used to improve the color, luster, and size of needles and also to increase the growth rate, stiffness, and vigor of leaders and branches. A bulletin published by the Washington State University Cooperative Extension Service provides detailed information on this subject.[5] Some highlights from this reference follow:

Slow growth Sites Low III, IV, and V, such as those found in Kitsap and Mason Counties in Washington, are most likely to benefit from nitrogen. Trees growing on these relatively infertile, dry sites frequently have light, yellowish needles and weak branches.

If the objective of fertilizing is to improve *both* needle appearance and growth rate, nitrogen should be applied in about March every year or two up to the time of harvest starting when the trees are 3 or 4 feet in height. If the objective of fertilizing is to improve the needle vigor and color *without* increasing growth rate, as in the case of lightly sheared trees, nitrogen should be applied during the bud swelling period in about April of the harvest year. If the trees are not harvested the same year that they are fertilized, delayed-action growth stimulation will occur during the following year. This necessitates corrective leader shearing and side shearing whenever the leader growth exceeds about 14 inches. The resulting sheared tree develops a much denser crown and stiffer branch structure than unsheared trees.

Nitrogen fertilizers, such as urea (46 percent nitrogen), ammonium nitrate (33 percent nitrogen), and ammonium sulfate (21 percent nitrogen), have usually proven to be more economical and just as effective as balanced fertilizers. Some soils are deficient in both nitrogen and sulfur. Under these conditions, ammonium sulfate may be the most effective form of fertilizer to use. Urea-sulfur and ammonium nitrate-sulfate fertilizers are also available on the market and, like ammonium sulfate, combine the benefits of nitrogen and sulfur.

Individual tree application is usually the best method. Unlike broadcast application, it permits varying the amount of fertilizer and time of application to suit the needs of individual trees. It also prevents growth stimulation of brush, ferns, and

This canvas back-pack carrier was designed especially for applying granulated fertilizer. It is easier to handle than a bucket, and reduces spillage.

[5] Darrell O. Turner and Joseph Buhaley, Washington State University, "Fertilizing Natural Douglas-fir Christmas Trees," Extension Bulletin #585, May 1966.

other ground cover between the trees. Granular type fertilizer is preferred because it is easy to spread under the dripline of the trees by hand or with a back-pack machine blower.

Amount of nitrogen per tree should be determined by trial and error for the least quantity that will do the desired job of needle improvement or growth stimulation. Suggested trial rates are 1/8 to 3/8 pound (actual nitrogen weight) per 6-foot tree crown. Experiments on low site lands in Kitsap County, Washington, indicate that 1/8 pound of nitrogen per tree will not increase growth appreciably the first growing season after application, but will increase it about 75 percent for several growing seasons thereafter.

Use of nitrogen increases the necessity and desirability of shearing. In effect, it raises the site quality of land on which it is applied. Prior to using fertilizer, an area may produce leaders only 8 inches long. These may suddenly increase to 16 inches on trees which were not cut the same year that they were fertilized. The grower is then faced with two alternatives. He can either sacrifice the tree by thinning it out as a cull or he can develop high quality by shearing. Increasing numbers of growers are finding that fertilizing, followed by shearing, is a profitable operation.

6. Planning for a Continuous Crop. — The following practices are used to help insure a sustained yield of trees year after year on cultured natural areas.

Stump Culture.—Stump culture is the practice of developing a new Christmas tree from a small limb or sprout left on the stump after a Christmas tree has been cut.

It should be considered where there is an inadequate stocking of natural seedlings to replace trees that are cut. To make this system work, a cluster or whorl of branches, making up not less than 10 percent of the total foliage of the tree, should be left on the lower stem well below the handle and as *close to the ground as possible.* This foliage should be lopped back to about one-half of its original length when the tree is cut to stimulate vertical sprouts. A year or two after the tree is cut, the most promising multiple sprout is selected to form a new tree and all the others are removed. Competing leaders and branches are gradually removed as the sprout begins to form a new tree. Some growers have produced three or four successive Christmas trees from a single stump.

Results are relatively poor where a stump culture utilizes an upturned branch instead of a sprout. Whorl development on a branch is likely to be incomplete for many years. The resulting tree will not readily develop symmetric shape. If a limb does eventually form a symmetric crown, it is likely to be too high above the ground for easy shearing.

Seed Trees. — Many managers of natural stands retain two to four older trees per acre for seed production to insure a perpetual crop of new seedlings. A common mistake is leaving an excessive number of seed trees per acre. They compete with the understory Christmas trees and appreciably lower both production per acre and quality.

Seed trees should be full crowned, healthy, and should have good Christmas tree form to increase the probability that seedlings will inherit desirable characteristics. Trees should be left in pairs or small groups, where possible, to facilitate cross-pollenization of cones. They should be pruned high to reduce shading of Christmas trees, but not more than one-third of the live crown should be removed. Viable seed production usually starts when the tree is about 30 years old.

Spot Planting.—Where seed trees are lacking or, for some reason, do not provide an adequate stocking of natural seedlings, unstocked spots should be hand planted. Planting stock grown from local seed source is recommended. Planted seedlings should be spaced about 5 feet apart. Hardwood thickets sometimes form canopies too dense for survival of seedlings. They should be cut, and stump-sprayed with a herbicide, to prevent sprouting before planting is attempted. Commonly used tools for spot planting on natural areas are planting hoes, planting bars, and sturdy tile drain shovels.

Developing a Two-Story Stand.—When trees are basal pruned several feet above the ground, adequate space is often provided to start natural seedlings under their canopies. These will have a head start when the overstory Christmas trees are harvested and frequently develop into a replacement more quickly and with less work than needed to develop a stump culture. Trees with the

est natural Christmas tree form should be selected for replacements and others, including poorly developed or excessive high stump cultures, removed.

Harvesting as a Method of Thinning.—Harvesting should be planned to provide adequate spacing for adjacent trees as well as to remove trees that are ready to market. Trees standing alone and not touching or shading other trees can be left a year longer than usual to develop 8-, 9-, and 10-foot sizes.

However, those that are crowded should be thinned to provide adequate growing space on all sides of those that are retained. Ideally, this thinning should be accomplished by harvesting the surplus trees for market. These provide a good source of supply for the 3-, 4-, and 5-foot sizes. Unfortunately, many trees that need immediate thinning are not of sufficient quality to market. In this case it is better to sacrifice the poorer trees by thinning than to spoil the future quality of all the trees by leaving the area overstocked.

D. PROTECTION

Protection from damage by animals, insects, diseases, fire, and trespass are covered in detail in the following publications:

"Raising Christmas Trees for Profit," Knut Lunum, Cooperative Extension Service, Washington State University, Revision 1968.

"Cultural Practices for Growing Christmas Trees in the Pacific Northwest," Bernard S. Douglass, U. S. Forest Service, Region 6, Portland, Oregon, June 1967.

"Disease Problems in Christmas Tree Production," Otis C. Maloy, Extension Mimeograph 2604 (Revised), Washington State University Extension Service, Revision October 1970.

"Diseases and Insects of Christmas Tree Plantings," Arthur Partridge, Otis C. Maloy, John A. Schenk, and David H. Brannon, Extension Mimeograph 2604, Washington State University Extension Service, Revision January 1967.

"Pests and Disease Control Guide for Christmas Trees," C. S. Davis, E. E. Gilden, C. S. Koehler, and A. H. McCain, Pub. AXT-130, University of California Extension Service, Revision January 1965.

"Why is My Evergreen Brown?" A. D. Partridge and J. A. Schenk, Idaho Agricultural Extension Service Bulletin 514, March 1970.

"Wildlife Feeding Injuries on Conifers in the Pacific Northwest," William Laurence, Nelson B. Kverno, and Harry D. Hartwell, distributed by Western Forestry and Conservation Association, Portland, Oregon, June 1961.

E. HARVESTING AND MARKETING

Refer to the following bulletin: "Christmas Tree Harvesting and Marketing for Pacific Northwest Growers," Bernard S. Douglass, U. S. Forest Service, Region 6, Portland, Oregon, 1971.

F. SOURCES OF ASSISTANCE AND INFORMATION

Services of a farm forester are available to most woodland areas in Oregon and Washington. The office address of the local farm forester can be obtained by inquiring at any State Forestry Department Office in Oregon or State Department of Natural Resources Office in Washington.

Reference material is available from the County Extension Agent. He can also advise growers concerning the availability of assistance from farm foresters, extension foresters, and others who work with Christmas tree growers.

Additional sources of Christmas tree culturing information are:

Extension Forestry Specialist
Agricultural Cooperative Extension Service
117 Forest Research Laboratory
Oregon State University
Corvallis, Oregon 97331

Extension Forest Resources Specialist
Agricultural Cooperative Extension Service
Washington State University
317 Johnson Hall
Pullman, Washington 99163

Extension Forestry Specialist
Agricultural Cooperative Extension Service
Western Washington Research and
Extension Center
Puyallup, Washington 98371

Local offices of the Soil Conservation Service

Special Products Forester
Division of State and Private Forestry
U. S. Forest Service
P. O. Box 3623
Portland, Oregon 97208

The Northwest Christmas Tree Association provides meetings, field tours, culturing demonstrations, and current literature for its members. Most Oregon and Washington growers and wholesalers belong to this association. The name and address of the current secretary may be obtained by contacting any of the above-mentioned sources of information.

Both the Oregon State and Washington State University Extension Services provide annual two-day short courses for Christmas tree growers. Your local extension agent can provide information on time, place, and agendas of these training sessions.

NATIONAL FOREST SYSTEM
COOPERATIVE FORESTRY
FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE
FORESTRY RESEARCH

(To be revised and put in Guide form as Guide #13)

U. S. FOREST SERVICE
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DEVELOPMENT OF A PLANTATION OF HIGH QUALITY SHEARED PINE CHRISTMAS TREES

(Step-by-Step Cultural Instructions)

A. Introduction

Shearing pines for Christmas trees is rapidly gaining acceptance in the Pacific Northwest. High quality sheared pines can be produced in Oregon and Washington by using the same cultural practices that have been developed and tested for many years by growers in the East and Lake States. Christmas tree wholesalers who purchase trees from various parts of the country have reported that sheared pines from the Pacific Northwest are of superior quality.

Pines are not as popular as firs for Christmas trees in the Pacific Northwest, accounting for only about 5% of total production. However, they are the most popular trees in the nation as a whole, and their popularity with growers and consumers in this region is increasing every year. Pines have the following desirable characteristics.

1. They are adapted to a wide range of climates, exposures, and soils.

2. A variety of attractive species are available; each with different characteristics.

3. They grow rapidly.

4. They are easy to shape and control.

5. They hold their needles and freshness well after being cut.

6. They are relatively free of serious insect or disease problems in most areas of this region.

7. They bring a good retail price, about halfway between Douglas-fir and noble fir.

Most growers are able to produce merchantable 6-and 7-foot sheared pines in 6 to 8 growing seasons after planting. Leaders are usually pruned back to grow about 12" in height per year.

Both unsheared and sheared pines are in demand for Christmas trees where leaders do not grow more than 12" - 14" per year. However, if growth exceeds this length, shearing is necessary to prevent widely spaced whorls and excessive width which causes trees to be of poor quality.

By: Bernard S. Douglass, Division of State and Private Forestry

B. Pines Recommended for Shearing

1. West of the Cascade Mountains. Scotch pine and shore pine are the most popular species. Both have attractive short needles, respond well to shearing, and are tolerant of dry infertile sites.

   Scotch pine, a native of Europe and Asia, has recently become the principal Christmas tree species in the United States. Selection of seedlings from a proper seed source is essential for Scotch pine because only a few of its many geographical strains are ideal for Christmas trees. French Auvergne strain with short, stiff, blue-green needles is one of the favorites. Although most tree nurseries identify their seed origin, a cautious Christmas tree grower will examine nursery seedling beds in December for winter-yellowing or poor vigor. This could indicate an inherited characteristic caused by undesirable seed source.

   Shore pine is native along the coast of Oregon and Southern Washingto Seed should originate from natural stands within 1 mile of the Pacific Ocean. Interior strains from Puget Sound and elsewhere have inferior color, density, branching, and bud producing ability.

   Two species with long needles--bishop pine and white pine--also appear to be good prospects for shearing. However, they need further testing before large scale planting can be recommended.

   Some species are not recommended for Western Oregon and Western Washington. Monterey pine does not harden off sufficiently to prevent wilting of shoots and needles when the tree is cut. Ponderosa pine fails to produce uniform branch whorls or adequate bud formation after shearing. Lodgepole pine and Austrian pine usually grow well, but color and branching habits do not measure up to competing species.

2. East of the Cascade Mountains. Non-yellowing strains of Scotch pine and Austrian pine are the recommended species. They combine good budding ability after shearing with drought resistance.

   Ponderosa pine and lodgepole pine are not recommended for shearing. Although they produce good unsheared, naturally-shaped Christmas trees in some areas, they fail to produce many buds on sheared branch tips.

C. Planting

A 5x5 foot or 5 1/2 x 5 1/2 foot spacing is adequate for producing trees 5 to 7 feet tall. This spacing can be adjusted for growing shorter or taller trees. Perfect spacing of trees to form check-rows in each direction is recommended because it simplifies culturing the trees. Hand planting a field marked in squares or along a wire marked at proper intervals are reliable methods of check-row planting. Although machine planting is cheaper and faster, few operators have acquired sufficient skill to plant in accurate check rows.

D. Weed and Grass Control

Pine plantations for developing sheared Christmas trees should be kept free of heavy grass and weeds. This improves survival and growth. It also eliminates the habitat for meadow mice, gophers, rabbits and other destructive rodents.

Frequent cultivation for the first 2 or 3 years is the most common practice for controlling grass and weeds. However, chemical herbicides, such as atrazine, are becoming increasingly popular. They usually prove to be less costly and more lasting then cultivation. Directions for use of herbicides should be obtained from your local farm forester or county agent.

Mowing, or a combination of mowing and chemicals, is usually substituted for cultivating after the second or third growing season when the trees have become well established. If continued cultivation is preferred, the equipment must be small enough and the bottom tree whorls developed high enough above the ground to prevent mechanical injuries to the branches.

E. Insect and Disease Control

1. Scale insects, aphids, twig weevils, or shoot moths may become a problem. It is much more effective and less costly to spray with insecticides at the very first sign of an outbreak than to wait until the plantation is badly infested. County Agents, farm foresters and forest entomologists can help to identify insects and recommend effective insecticide treatments.

2. The most serious diseases on pines are needle cast diseases,gall rust, blister rust and twig blight. Needle cast diseases are particularly troublesome in areas of heavy rainfall where air circulation is poor. Since shearing creates a dense tree that holds moisture and restricts air circulation, it may also increase the incidence of needle cast diseases. County agents, farm foresters and forest pathologists can help to identify diseases and recommend proper sprays. Growers should be constantly on the lookout for any unusual build-up of disease. It is much easier to stamp them out in their earlier stages before they gain a foothold.

F. Description of Cultured Techniques

1. Basal Pruning. Locate a good bottom whorl with 5 or more strong evenly spaced branches. It should not be lower than 12 inches above the ground to permit an adequate handle and must be above heavy shade caused by grass and weeds. Pines frequently have crooked lower stems. It is desirable to provide a fairly straight handle even if this requires selecting a bottom whorl higher above the ground than would have been selected for straight stemmed trees.

Caution: Do not culture pines during late winter or early spring when new buds first start to elongate. Buds at this time are very loosely-seated and will snap off if the tree is jarred. If the normal practice of replacing cut trees with new planting is planned, all of the branches below the bottom whorl of the Christmas tree should be cut flush with the bark. If stump culture is planned, a whorl of branches should be retained below the base of the handle near the ground to keep the stump alive after the tree is cut.

2. Shearing. When pines are sheared during the succulent stage, new growth is not dependent on existing buds as with fir and spruce. In about six weeks each succulently sheared branch and leader will produce new buds from the base of needles within about one inch of the cut. This characteristic makes it possible to shear pines to any desired shape with assurance of future bushy growth. Shearing, once started, should be continued each year until the tree is harvested.

The season to start shearing varies from late-May to mid-June. It should be started when new growth is fully elongated, but still tender and succulent. Many growers judge that the proper stage of growth to begin shearing is when the new needles are half as long as last year's needles. Shearing may be continued thereafter for a period of about five or six weeks, or until the new growth hardens off and bud formation is no longer reliable. Shearing too early in the succulent stage gives poor results because the cut branches may further elongate and spoil the symmetrical appearance of the tree. Shearing too deeply into two-year-old wood likewise gives poor results because bud formation either fails or is delayed a full year.

The first step in shearing a pine is to cut the leader off at a 45° angle to encourage formation of a single strong leader bud on the high point of the cut. A hand pruner or knife is a good tool for doing this job. Recommended sheared leader length is 12" for Scotch, shore, white, Austrian and other pines with short to medium needles.

Leaders are sometimes sheared an inch or two longer for long-needles pines with upright branches, such as bishop pine and knobcone pine. Leaders should not be cut back if natural leader growth does not exceed about 12", but the side branches should still be sheared in the usual manner.

The second step is to cut the tips of the side branches to form a uniform, rather narrow conical shape. This is usually accomplished by making sweeping, downward strokes with a sharp, thin knife having a 14" to 16" blade. Some growers prefer to use a hedge shears to shape the tree instead of a shearing knife. The top whorl should be cut about 40% as long as the sheared leader. Some growers accomplish this by gathering all the branches of the top whorl together in one hand,pulling them upward and cutting them to the same length with a single cut.

Others shear the top whorl along with the lower branches as part of the operation to form a near perfect cone. The latter method is always recommended for the final shearing before the tree is cut in order to avoid a stair-step profile near the top of the tree.

Multiple leaders sometimes form on pine trees that were sheared during the previous year. In this case, the best leader should be selected on the basis of vigor and central location in the clump formed by the top whorl. All competing leaders should be either removed or cut back to the same length as the lateral branches of the whorl.

G. Step-by-Step Cultural Instructions

1. First Growing Season. Concentrate only on keeping the trees alive and growing. Weed and grass control is essential for good survival. The only pruning would be removal of double leaders or other obvious deformities.

2. Second Growing Season. Do not start to shape a tree until it has developed sufficiently to produce a good bottom whorl with five or more evenly spaced branches and a 12" or longer stem below the good bottom whorl which will produce a straight 9" handle.

   Trees meeting the above requirements and having a leader more than 12" long should be cultured as follows:

   a. Basal prune below the good whorl.
   b. Prune the leaders back to a 12" length.
   c. Prune the lateral branches of the good whorl to a 5" length.

   Trees meeting the above requirements but having a leader less than 12" long should be cultured as follows:

   a. Postpone basal pruning another year to prevent stunting next year's growth.
   b. Do not prune the leaders.
   c. Prune the lateral branches of the top whorl to 40% of the leader length. If the lateral branches are already this short or shorter, no culturing is required.

3. Third Growing Season. Use the same guide shown above for those trees that need culturing for the first time.

Trees being cultured for the second time should be treated as follows:

a. Prune the leader back to a 12" length.
b. Prune the branches of the top whorl to a 5" length.
c. Shear the tips of the lower whorls to form a near perfect cone-shaped crown with a 50% taper. Percent taper means the width of a tree expressed as percent of its height.

4. Fourth Growing Season. Same culture as for third growing season. Crowns of most trees will vary from 1' to 3' in height at this stage of growth.

5. Fifth Growing Season. Same culture as for previous growing season.

6. Sixth Growing Season. Trees that will not be harvested this year should be cultured the same as for the previous growing season.

   A few of the larger trees with crowns 5' or more in height may be ready to harvest for Christmas. Most of the trees should be left to grow to larger, more profitable sizes.

   Those trees that will be harvested should be permitted to widen to a taper of 65% to 70%. This is accomplished by carefully shearing only the tips of the longer branches to form a near perfect cone-shaped crown. Light shearing the last year produces long, feathery, natural-shaped branch tips which most customers prefer.

7. Seventh Growing Season. Much of the remaining crop will be harvested this year as 6' and 7' Christmas trees. As described above, trees ready to harvest should be sheared very lightly and skillfully to produce a taper of 65 - 70% and natural appearing branches.

   Those trees that will not be harvested until next year should be cultured the same as for previous seasons.

8. Eighth Growing Season. All of the remaining trees will likely be harvested this year. They should be cultured the same as previously described for trees ready to harvest after the sixth and seventh growing seasons.

   If stump culture is practiced, an uneven stand of new Christmas trees can be developed from branches or sprouts on the old stumps. If a new plantation is desired, the old stumps would be pulled out of the ground and the area cultivated for a new planting of seedlings.

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

PACIFIC NORTHWEST REGION–STATE AND PRIVATE FORESTRY

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DEVELOPMENT OF HIGH QUALITY SHEARED PINE CHRISTMAS TREES

Page

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FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

A. INTRODUCTION

Sheared pines for Christmas trees are rapidly gaining acceptance in the Pacific Northwest. High quality sheared pines can be produced in Oregon and Washington by using the same cultural practices that have been developed and tested for many years by growers in the Eastern and Lake States. Christmas tree wholesalers who purchase trees from various parts of the country have reported that sheared pines from the Pacific Northwest are of superior quality.

At the present time mainly fir species are produced for Christmas trees in the Pacific Northwest. Pine species account for only about 5% of total production. For the nation as a whole, however, pines are the most popular trees, and their popularity with growers and consumers in this region is gradually increasing. Several large retailers in Portland and Seattle for example, who offer a complete selection of species, report that pine accounts for about 10% of their total sales.

Pines have the following desirable characteristics:

1. They are adapted to a wide range of climate, exposures, and soils.

2. They hold their needles and freshness exceptionally well after being cut.

3. They are relatively free of serious insect or disease problems in most parts of the Pacific Northwest.

4. They are easy to shape and control.

5. Several attractive species are available, each with different characteristics.

6. They develop moderately fast--about 7 to 9 years for the popular 5½' - 7½' heights--in well-managed plantations.

7. They bring a good retail price about midway between unsheared Douglas fir and noble fir, or about the same as for sheared Douglas-fir.

Most pines grown in the Pacific Northwest are field planted and sheared annually to control shape and density. However, there are some exceptions to this general practice. Perhaps 25% of the pines produced in the Pacific Northwest are left unsheared for those consumers who prefer the open-type tre with natural branches. Some of the unsheared pines are produced in lower-site plantations where leaders grow no more than 12" or 14" per year. Howeve most of them are harvested from slow-growing natural stands of ponderosa pine and lodgepole pine in eastern Oregon and Washington, and from stands of shore pine and white pine west of the Cascade Mountain summit. Management of unsheared pines is not covered in this publication--only mentioned briefly to round out the picture of pine Christmas tree production.

A shearing knife is used to improve shape and density in this natural stand of shore pine.

Very few sheared pines are produced in natural stands as compared to plantations. These consist mostly of shore pine and white pine, which are sheared similarly to plantation-grown trees. Shearing natural stands of ponderosa pine and lodgepole pine is not recommended generally because they do not respond after shearing with new buds as well as most other pine species.

B. PINE SPECIES RECOMMENDED FOR SHEARING (Listed in descending order of importance)

1. Western Oregon and Washington.

a. Scotch Pine(Pinus sylvestris) This native of Europe and Asia has recently become the principal Christmas tree species in the United States. It is widely grown in the Eastern and Lake States. It is also well-adapted to the Pacific Northwest.

Needles are short, in bundles of two, and are very durable after the tree is cut. Budding response after succulent shearing is reliable over a relatively long, 4 to 6 weeks shearing season.

Proper selection of a Scotch pine seed source is extremely important to Christmas tree growers. Some Northwest plantations have trees with yellowish needles, excessive crookedness, or poor growth that can be attributed directly to poor inherited characteristics. Provenance tests at Olympia, Washington rated two strains especially high. The Spanish strain (variety iberica) produces short, stiff, blue-green needles. The most promising Spanish seed source was the Guadarrama Mountains north of Madrid. The southern German strain (variety haguensis) is faster growing than the Spanish and produces longer, more flexible, lighter green needles. Highest rated southern German seed sources were Pfaltz and Wurttemburg. Although most tree nurseries identify their seed origin, a cautious Christmas tree grower will examine nursery seedling beds in December for color, vigor, root development, stem straightness, and stem calibre. Weaknesses in these characteristics could indicate inherited problems from undesirable seed source.

Well-managed sheared Scotch pine from the Pacific Northwest are unsurpassed for color and profusion of needles.

b. Shore Pine (Pinus contorta) variety contorta). This is the coastal variety of lodgepole pine. Its natural range extends along the Pacific Coast from southern Alaska to central California. Like Scotch pine, it has short needles in bundles of two. The needles of shore pine are brighter green in color and more flexible than Scotch pine. Budding response after shearing is variable unless trees are sheared during a relatively short period in the early stages of succulent growth.

Selection of proper seed source is as important for shore pine as for Scotch pine. The only recommended seed source is from trees within one mile of the Pacific Ocean along the coast of Oregon and southern Washington. East side and Rocky Mountain lodgepole pine strains (Pinus contorta, var. latifolia) are inferior to shore pine in color, density, branching, and budding response. Shore pine forms other than those found along the Pacific Ocean, such as found

in the Cascade Mountains and Puget Sound basin also show many of the deficiencies of lodgepole pine, although to a lesser degree. Unfortunately, the differences between lodgepole and shore pine, and between the various forms of shore pine, are too subtle to detect during the seedling stage. Growers must depend on the integrity of their seedsman or nurseryman as to seed origin.

Gary H. Sander, Extension Forester for the State of Oregon, is currently sponsoring provenance tests for the coastal form of shore pine. Ten seed sources from Arcata, California to Westport, Washington are being systematically compared for suitability as sheared Christmas trees. These tests will eventually provide more localized seed source recommendations.

A lodgepole pine (center) is compared compared with a Scotch pine (left) and shore pine (right). All trees have been established for 7 years in the plantation.

c. Austrian Pine (Pinus nigra). This pine, like Scotch pine, is a native of Europe and Asia. Like Scotch pine, it occurs over a wide geographical range and is represented by several varieties. Varieties from certain Austrian pine seed origins produce excellent Christm trees; others have poor color, inferio branching habit,and deficient terminal bud development.

Needles are moderately long, stiff and in bundles of two. Budding response of desirable strains is reliable when the trees are sheared during the early stages of succulent growth.

More research is needed in selecting tl best seed origins of Austrian pine for sheared Christmas trees. Lee Wells, Northwest Area Supervisor of the J. Hofert Co., reports good results from a source south of Vienna, Austria. Dr. Lester E. Bell, Michigan State Extension Forester, reports straight stems, slow growth, and dark green foliage from the Austrian Alps seed source.

d. Western White Pine(Pinus montic This pine is native to the West Coast and northern Rocky Mountains. Needles are medium length, bluish-green in colc soft textured, and occur in bundles of five. Budding response after shearing is variable unless trees are sheared during a relatively short period in the early stages of succulent growth. One reason that it is not more widely planted is its susceptibility to the deadly white pine blister rust disease. Relatively short rotations for Christma trees, however, should permit escape from the effects of this disease in man areas. White pine is undoubtedly worth bigger trials than are being made at th present time.

e. Bishop Pine (Pinus muricata). This pine is native to the coastal area of California. Needles are long, olive green in color, occur in bundles of two and are much softer textured than ponderosa pine, which it resembles somewhat. Budding response after shear ing is excellent over a moderately shor shearing season. Bishop pine lacks winter hardiness in unusually cold

anting areas, such as east of the scades, and ranks between shore pine d the extremely tender Monterey pine this respect. It often shows high rst-year mortality in new plantations t, once established, it is quite ought-resistant and will usually grow re vigorously than any of the other commended pines.

2. Eastern Oregon and Washington (described in approximate descending order of importance).

a. Scotch Pine (Pinus sylvestris). commended varieties are the iberica om Spain and acquitana from southern ance. Scotch pines from the adarrama Mountain seed source from govia Province in Spain were rated ghest of those represented in a prov- ance test by the University of Idaho ar Orofino. Other Spanish seed sources d the French Auvergne seed sources so rated higher than average.

b. Austrian Pine (Pinus nigra). st side recommendations are the same for western Oregon and Washington. od quality sheared trees have been ported on irrigated lands near Moses ke, Washington.

e native east side pines are generally t recommended for shearing because ey show poor budding response after earing. This is true especially of nderosa pine, which is a notoriously or budder under even the best of site nditions. It generally is true of dgepole pine as well, especially on pical lodgepole sites where annual infall is under about 25". Exceptions lodgepole pine have been reported for me of the better sites in northeastern shington when shearing is confined to 10-day period during the early succu- nt stage.

C MATCHING SPECIES TO SITE

nes are more tolerant of poor site nditions than Douglas-fir and true rs. For this reason, some growers ant them on eroded southwest exposures, in heavy clays, rocky soils, lowlands with high-water tables, in frost pockets, and similar adverse sites where other species will not survive or attain merchantable quality. While this practice may be sound from the standpoint of complete land utilization, it certainly does not produce the best quality sheared pines. The ideal pine site is commonly a deep, well-drained sandy loam soil on a level to gentle southerly or westerly exposure. The fact that pines produce merchantable quality on less than ideal sites speaks well for their versatility as a Christmas tree species.

Regardless of their versality in site tolerance, pines ordinarily should not be planted under the following conditions:

1. At higher elevations where heavy snow may crush and deform the trees. West side pine plantations above 800' - 1000' frequently show deformation from snow damage.

2. In poorly drained, clay-type soils, these conditions cause stunted growth, droopy branches, and unthrifty needles.

3. In windy areas where soil is poorly drained. These combined conditions cause the trees to lean in the soil away from the prevailing winds. The continuous effort required to straighten the stem to an upright position is both costly and time consuming.

4. In heavy sod, grass, weed, or brush cover that cannot or will not be eliminated by chemicals or cultivation. Pines are less tolerant of soil competition from grass, weeds, and brush than most fir species. Also shading suppresses and defoliates them more than firs.

5. In heavily populated gopher areas. Pine species, especially Scotch and Austrian pine, are a preferred food of pocket gophers. Damage is

greatest where grasses and weeds, which provide a favorable habitat, are left unchecked. Damage is accomplished by girdling and eating the roots just under the ground. The grower may not be aware of the extent of the damage until the trees turn yellow or topple over for lack of root support. Baiting or trapping is an effective remedy where only a few gophers occur. However, gophers can be extremely difficult and costly to control where they continuously invade a plantation from heavily infested adjacent areas.

6. On northerly and easterly exposures of more than about 10% slope. Pines are sunlight lovers, and prefer level to southerly or westerly exposures. Northerly and easterly exposures are cooler and better for planting true firs.

D. PLANTING

1. Ground Preparation.

Pines have poor survival and growth where grass and weeds grow rank and unchecked. This competition consumes moisture and robs nutriments from the soil, shades and suppresses planted seedlings, and furnishes a habitat for mice, gophers, and other pests.

Planting pines in uncultivated grasslands is a waste of time and money.

Fields should be deeply plowed, disked and harrowed to eliminate existing grass and weeds before planting. Old fields and pastures with heavy sod may require summer fallowing to break down the sod. Fields with heavy infestations of blackberry, bracken fern, Canada thistle, and other Atrazine-resistant species may require repeated cultivation or application of sterilent type herbicides prior to planting.

Old fields require summer fallowing to break down heavy sod prior to spring planting time.

2. Plantation Design and Layout

Spacing the trees 5' x 5' to 5½' x 5½' is adequate for producing the popular 5½' to 7½' tall trees. This spacing can be adjusted somewhat for producing shorter or taller trees, or to permit operation of extra-wide equipment between the rows.

Planting in perfect squares, called "check rowing", permits mowing or cultivating in two directions and provides a more orderly appearance than random spacing within each row. Check rowing, however, is difficult to accomplish with machine planting. Many growers do not believe that the additional cost of check rowing is justified when chemicals can be used to control grass and weeds.

acing 5' x 5' requires about 1740 ees per acre and $5\frac{1}{2}$' x $5\frac{1}{2}$' requires out 1400 trees per acre when every re is planted solidly with trees. In tual practice, about 150 fewer trees r acre will permit skipping two jacent rows at intervals of every 20 30 rows for firebreaks and access adways. Weed and grass-free fire-eaks are also recommended around ammable perimeters of the plantation, rticularly next to public roads.

en a grower has several aspects on his anting area, he should ideally plant nes on the steeper southerly and sterly exposures which they tolerate ry well. This will leave the steeper rtherly and easterly exposures for anting true firs and level to gentle oping exposures for Douglas-fir.

3. Planting Stock.

edlings may be purchased from the ight L. Phipps Forest Nursery, c/o egon State Department of Forestry, lem, Oregon, or the Mike Webster rest Nursery, c/o State of Washington partment of Natural Resources, Olympia, shington. They may also be purchased om several private tree nurseries ich specialize in Christmas tree stock. eck with your local forester.

anting stock should be ordered well in vance of planting and arrangements de for delivery or pickup just prior planting. Seedlings are packed in terproof bags or tight bundles at the rsery for shipping. Water should ways be poured through open-ended ndles as soon as they arrive, to plenish lost moisture. If possible, ees in sealed bags should be stored a 35° to 40° F cooler prior to plant-ig; otherwise, store them outdoors in a cool spot. Unless outdoor-stored ees will be planted within about a ek after delivery, they should be moved from their package and heeled where there is protection from root dying, direct sunlight, and drying winds.

Planting stock of uncommon species or strains may not be available from state or private commercial nurseries. If so, you may:

a. Obtain seed from the desired source and grow your own stock in a home nursery. Instructions are found in "Raising Forest Tree Seedlings at Home", PNW #96, December 1967. This bulletin is available from your State Extension Forestry Specialist or County Extension Agent.

b. Arrange to have a commercial nurseryman custom-grow seedlings from seed that you furnish.

c. Pull or dig wild seedlings of planting stock size. Roots should be trimmed to 8" long. Also about half the total live branches on the seedlings should be pruned from the lower stem to compensate for root loss. Growth rate and survival will be improved by building up the trees for one year in a transplant bed. Caution: Always obtain the landowner's permission before taking wild seedlings.

This home nursery features shore pine seedlings from parent trees with superior Christmas tree characteristics.

4. Planting Techniques.

Planting requires special techniques for good survival. Your farm forester should be consulted. A few general planting recommendations follow:

a. Spring planting is usually better than fall planting, especially on heavy soils that tend to "frost heave".

b. A tractor-drawn machine planter will plant 10 to 20 times faster than hand planting. Machines are recommended for planting larger areas where slope and soil conditions will permit them to operate. Machine plant only when soil moisture and weather conditions permit a good planting job.

E. GRASS AND WEED CONTROL

Effective grass and weed control is one of the most important keys to producing high quality Christmas trees, regardless of the species. Methods follow:

1. Chemicals.

Atrazine spray has largely replaced the older and more costly methods of cultivating or mowing between the rows. This chemical will not damage the trees when applied as a wettable powder. New chemicals are being tested continuously, and latest recommendations and directions for use should be obtained from your Farm Forester or County Extension Agent.

Atrazine is applied immediately after planting in February, March, or early April. Thereafter, if a grass or weed problem persists, the trees can be resprayed every year in February or March before grass and weeds start spring growth. Field sprayers, with booms and mechanical agitators to keep the chemical from settling out, are the usual spray equipment when trees are small enough to operate over their tops without damage. Later, as trees become larger, airplanes, helicopters, or narrow-gauge ground sprayers that will work between the rows can be used successfully.

Grass and weeds are competing with these field-planted shore pine. Application of Atrazine in February or March will remove most of the competing vegetation without harming the trees.

Weeds and grass have been effectively controlled in this 2-year-old Scotch pine plantation by spraying every year with Atrazine.

2. Cultivating.

lthough largely replaced by chemical praying, cultivation is useful for ontrolling Atrazine-resistant grass nd weed species and for aerating ompacted, cracked, clay-type soils. onventional farm cultivators may be sed when the trees are small. Larger rees require narrow-gauge, shallow-igging, rotary-type cultivators that ill operate between the rows without amaging the branches.

3. Mowing.

his is effective for controlling Atra-ine-resistant grass and weed species. eeping competing vegetation down onserves soil moisture, eliminates the abitat for pests, and allows for fuller nd better development of bottom whorl oliage.

owing is also useful where a low vege-ative cover is desired between the rows o control erosion or to prevent muddy arvesting conditions. Recommended mow-ng equipment is low-profile, narrow-auge rotary or hammer-types that shred he grass and weeds into small particles. eflectors should be installed on mowers o prevent accidental damage to lower ranches.

. PRESHEARING CARE

he main jobs before a plantation is ufficiently developed for its first hearing are:

1. Weed and grass control, which is escribed in the previous section.

2. Replacing dead trees.

3. Removing all multiple leaders xcept the best one by cutting them off lush with the main stem.

4. Protecting trees from fire, odents, deer, livestock, insects, and isease. Fire trails, fencing, baiting, rapping, or spraying may be necessary. efer to Section J, "Protection".

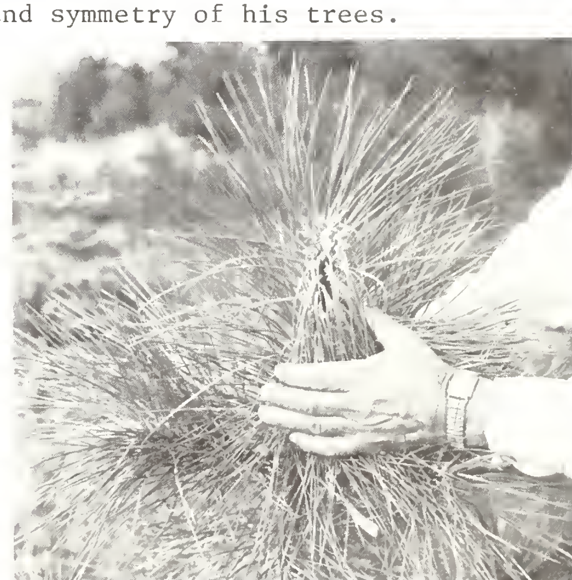
G. PINE SHEARING TECHNIQUES

1. How Pine Responds to Shearing.

Pine, unlike fir, does not produce inter-nodal branches between the whorls. Thus, unsheared trees develop excessive bare spans called "goosenecks" between the whorls unless excessively long leaders are cut back to proper length. At the same time that the leaders are cut back, it is necessary to also cut back the tips of the lateral branches to form a near perfect, rather narrow, cone-shaped crown.

Fortunately, most pines will respond well to shearing. Techniques, developed over a period of many years by growers in the East and Lake States, produce excellent results in the Pacific Northwest.

Pines must be sheared in early summer when the new shoots or candles are still tender and succulent. Approximately six weeks after shearing, tips of succulently sheared branches will form a new cluster of buds at the base of the needle fascicles. The new clusters contain many more buds than unsheared branch tips, which results in a compact bushy tree. Thus, the pine grower can maintain control over the shape, taper, and symmetry of his trees.



Good bud formation is shown on the tip of a bishop pine leader 2 months after shearing.

2. Shearing Season.

Shearing is usually started some time in the month of June. It is not possible to designate the exact date to start shearing because this varies a great deal with weather conditions, elevation, latitude, exposure, and species. It can be defined morphologically, however, by comparison of the length of the newly formed needles on early summer shoots or candles with the length of the mature, fully elongated needles on the older branches. Time to begin shearing, as well as the duration of the shearing season once it has begun, will vary for the different pine species as follows:

a. Scotch pine. This pine is the most reliable and abundant bud producer. It also has the longest shearing season. Shearing should start when the new needles are one-half as long as the old needles. Thereafter, the shearing season may safely continue about four weeks. In an emergency, the shearing may be continued an additional two weeks, but budding response will decline steadily as the new growth hardens off.

b. Other pine species. Shearing may start when the new needles are one-third as long as the old needles. Thereafter, the shearing season may safely continue about two weeks.

3. Year to Start Shearing.

Shearing of medium and short needled pines, such as Scotch, shore, western white, and Austrian pine, should begin when the tree first develops a leader that exceeds approximately 12" in length. It should begin on long needled pines, such as bishop, when the tree first develops a leader that exceeds approximately 14" in length. A few pines in a plantation may be sufficiently developed to begin shearing after only two growing seasons in the plantation. Most of the trees will likely require an additional growing season to develop an adequate leader handle, and bottom whorl. Once started shearing must continue each year until the tree is ready to harvest.

4. How to Shear.

The objective of shearing pine is to form a near-perfect, rather narrow-tapered cone. Along with these shape requirements, the tree should be moderately dense and free of "holes" or visible internodal spaces. It should also have branches with a natural, feathery appearance that are free of unsightly stubs or a "heavy cropped" appearance.

This shore pine, having developed a new leader more than 12" long, is ready for its first shearing.

The same pine is shown after shearing and basal pruning.

An excessive span between the 2nd and 3rd whorl of this sheared western white pine will be difficult to fill in with branches. Shearing should have been started 1 year earlier to shorten the 15" leader that caused the opening.

ll this is a rather large order. The ollowing instructions will help to ttain these objectives:

a. Shearing the leader and top whorl. ne leaders of Scotch, shore, western nite, and Austrian pine are sheared nnually to about 12" in length. The eaders of longer needled pines, such as ishop, may be sheared an inch or two onger. Some shortening of these recom- ended leader lengths is frequently ecessary for individual trees that are oproaching harvesting size but appear o lack sufficient branch vigor to hide ne internodal spaces completely.

ne leader should always be sheared at a 5^{o} angle to encourage formation of a ominant bud near the top of the slant- ng cut to form next year's leader.

t the same time, the branch tips of the op whorl are cut back to about 40% of ne sheared leader length. Exception o this 40% rule should be made if shear- ng this close to the main stem would remove all of the needles from the sheared branch. Pine branches characteristically lack needles on a short section next to the stem. Budding response will not occur unless at least an inch or two of needles are left on the sheared branch tip beyond this bare section.

Sometimes the natural leader growth does not exceed 12" on a tree that has been sheared in previous years. In this case, the tip of the leader should be cut back slightly to stimulate formation of a greater number of terminal buds. At the same time, the lateral branches of the top whorl should be cut back to 40% as long as the sheared leader.

b. Shearing the side branches and establishing the taper.

After the leader and top whorl are sheared, the middle and lower portions of the tree are side-sheared to extend the cone-shape to the bottom whorl and establish the taper. Taper is defined as the width of the tree expressed as a percentage of its height. It should be quite narrow (about 50%) for the first 3 or 4 shearings and increased to about 60% for the final shearing before harvest. This widening permits skillful finish-shearing by light cutting of only the longer branch tips. Resulting appearance is natural and stub free.

When trees are sheared each year, it should not be necessary to cut into 2-year-old wood. Doing so produces poor results because bud formation either fails or is delayed a full year.

c. Shearing tools.

Some growers shear the leader and top whorl with a hand pruner as a separate operation from shearing the lower side branches. Others shear both the leaders and all the lateral branches with a knife or hedge shears as a single operation. Basic techniques are the same both ways.

A double-edged hand pruner is the most effective tool for cutting the leader

and top whorl when this operation is done separately from the side shearing.

Shearing knives and hedge shears are the most popular side shearing tools. The main advantage of the hedge shears is safety; the main advantage of the shearing knife is greater speed.

This bishop pine produced a second flush of growth (lammas growth) in August following shearing in June. This condition does not require late summer corrective shearing except in rare cases where the regrowth creates a new leader more than 12" in length.

Most effective knife shearing is accomplished by long sweeping downstrokes with a thin, sharp knife 12" to 16" long. Leg protectors are strongly advised for safety; also, leave two rows of trees between workers to prevent accidents.

Hedge shears are usually held upside down to make the angle of the blades conform with the contour of the tree. The tree is clipped from the top downward, using a series of quick strokes.

H. BASAL PRUNING

1. Purpose.

Basal pruning removes unwanted lower branches between the bottom whorl of the Christmas tree and the ground. It should form a handle of at least 1" per foot of tree height. Crooked handles are a serious, but common defect on pine Christmas trees. Basal pruning, therefore, should be sufficiently high to form a reasonably straight handle, even when this requires selecting a bottom whorl farther from the ground than would have been selected for a straight-stemmed tree.

The selected bottom whorl should contain a complete whorl of five or more branches. It is better to select a higher bottom whorl than to try to build the tree above one that is incomplete or deformed.

2. When to Basal Prune.

Premature basal pruning may overshock the tree, thereby stunting future growth and unnecessarily lengthening the time to develop a tree of merchantable size. A good rule of thumb to avoid overshock from basal pruning is to delay doing it until not more than 25% of the branches would be removed. This stage of development frequently occurs after the tree has been sheared the second time.

3. How to Basal Prune.

All branches below the selected bottom whorl should be cut flush with the stem. Avoid both stubs and heavy scars. Hand pruners are commonly used for this job. Some growers prefer using a short, heavy knife or machete, but care must be taken to avoid girdling by cutting the branches too close to the main stem.

Caution: Do not basal prune during late winter or early spring when new buds first start to elongate. Buds at this time are very loosely seated and will snap off if the tree is jarred.

I. YEAR-BY-YEAR CULTURAL SCHEDULE FROM PLANTING UNTIL HARVEST

1. First Season.

Concentrate only on keeping the trees alive and growing.

Weed and grass control is essential for good survival. The only pruning would be removal of double leaders or other obvious deformities.

2. Second Growing Season.

Do not start to shear a pine until it has developed sufficiently to produce a good bottom whorl with five or more evenly spaced branches above a reasonably straight handle 6" or longer. A few trees may attain this degree of development during the second growing season.

Trees meeting the above requirements and having a leader more than 12" long should be cultured as follows:

a. Shear the leaders back to a 12" length.

b. Shear the lateral branches of the top whorl to 40% of the sheared leader length, or about 5" long.

Trees meeting the above requirements but having a leader less than 12" long should be cultured as follows:

a. Do not shear leaders if they contain five or more good lateral buds. If the leader contains fewer than five buds, shear off the tip just below the natural bud formation to stimulate development of more buds.

b. Prune the lateral branches of the top whorl to about 40% of the leader length. If the lateral branches are already this short or shorter, they need not be sheared. Basal pruning should be delayed one more year if doing it now would remove more than 25% of the total tree foliage.

3. Third Growing Season.

Use the same guide shown above for those trees that need culturing for the first time.

Trees being cultured for the second time should be treated as follows:

a. Shear the leader back to a 12" length.

b. Shear the branches of the top whorl to 40% of the sheared leader length.

Multiple leaders frequently occur and should be treated as follows: Select a vigorous,centrally located multiple leader and shear it the correct length for a leader. Shear back all the other multiple leaders to the same length as the other branches in the top whorl.

c. Shear the tips of the lower whorls to form a near perfect cone-shaped crown with a 50% taper.

d. Basal prune below the bottom whorl whenever so doing will not remove more than 25% of the total tree foliage.

4. Fourth Growing Season.

Same culture as for third growing season. Sheared crowns of most trees will vary from 1' to 3' in height at this stage of growth.

5. Fifth and Sixth Growing Seasons.

Same culture as for previous growing season. Observation should be made at this point to determine if any large openings or other irregularities have developed in the crown. If so, shorten the leader to 8" to 10" instead of 12" to permit time for the crown to fill in adequately. Whenever a leader is shortened to less than 12", the sides of the tree should be sheared somewhat tighter than usual to prevent an excessively wide taper.

6. Seventh Growing Season.

Most of the pines are too small and open-branched to harvest. They should be sheared in the usual manner.

However, some of the faster developing trees with full crowns 5½' or more in height may be ready for Christmas. These should be finish sheared to widen their tapers to 60%. This is accomplished by carefully shearing only the tops of the longer branches to form a near perfect cone and more natural appearance.

7. Eighth Growing Season.

Most of the remaining trees should be ready to harvest this year. These should be lightly finish sheared, as described in the previous paragraph.

Some of the slower developers will require an additional growing season to attain merchantable height or density. These should be sheared the same as for the previous season.

8. Ninth Growing Season.

All of the remaining crop will likely be cut this year. Trees having salable quality should be finish sheared. Trees that are obvious culls need not be sheared. They may provide a source of salable boughs.

J. PROTECTING THE TREES

Principal pine tree pests in the Pacific Northwest are described below. Specific recommendations for their control should be obtained from your county extension agent or farm forester.

1. Animals.

Pocket gophers are usually the most troublesome of the animal pests. They eat and girdle the roots, causing the trees to die, decline in vigor, or topple over. Scotch and Austrian pines are the most susceptible species. Baiting and trapping are effective controls. However, constant vigilance is required to control reinvasions of these burrowing rodents.

Meadow mice girdle small trees close to the ground. Eliminating grass and weeds is usually all that is needed to cause them to move out of a plantation. Baiting is the most effective control where grass and weeds are not removed.

Mountain beavers and rabbits clip branches in some areas. Baiting and trapping are most effective controls.

Livestock should be excluded by fencin[g]

Deer sometimes damage pines by rubbing off bark with their antlers. Contact your State Game Department for suggestions on deer control.

2. Insects.

European shoot moth larvae hollow out t[he] new buds on Scotch, shore, and Austrian pines. Shearing usually removes most, but not all, of the infected buds.

Spittle bugs form frothy white spittle on the succulent shoots. Shore pine and Scotch pine are particularly susce[p]tible. Infected shoots become dwarfed deformed and yellowish.

Pine needle scale insects appear as conspicuous white scales on the needle[s] of Scotch, Austrian, and shore pines. They cause trees to decline in vigor and infected needles to turn yellowish Honey drip secretions sometimes cause sooty black deposits.

3. Diseases.

Dothistroma needle blight causes red colored bands and shedding on shore, Austrian, Monterey, and bishop pine needles. Trees growing in areas of heavy rainfall, such as along the coas[t] are particularly susceptible.

White pine blister rust causes pitchy cankers on the stems and branches of western white pine, sugar pine, and other 5-needled pines. The cankers eventually kill the tree.

Western gall rust causes swollen canke[rs] with orange spores on shore and lodgep[ole] pines.

he best control method for both types f rusts is to cut out infected branches r harvest the trees before the branches ie.

dditional information on animals, nsects, and diseases as well as infor- ation on fire and trespass control are ound in the following publications:

"Raising Christmas Trees for Profit", Knut Lunnum, Cooperative Extension Service, Washington State University, Revision 1968.

"Cultural Practices for Growing Christmas Trees in the Pacific Northwest", Bernard S. Douglass, U.S. Forest Service, Region 6, Portland, Oregon, June 1967.

"Diseases and Insects of Christmas Tree Plantings", Arthur Partridge, Otis C. Maloy, John A. Schenk, and David H. Brannon, Extension mimeograph 2604, Washington State University Extension Service, Revision January 1967.

"Pests and Disease Control Guide for Christmas Trees", C. S. Davis, E. E. Gilden, C. S. Koehler, and A. H. McCain, Pub. AXT-130 University of California Extension Service, Revision January 1965.

"Wildlife Feeding Injuries on Conifers in the Pacific Northwest", William Laurence, Nelson B. Kverno, and Harry D. Hartwell, distributed by Western Forestry and Conservation Association, Portland, Oregon, June 1961.

. HARVESTING AND MARKETING

efer to the following bulletin:

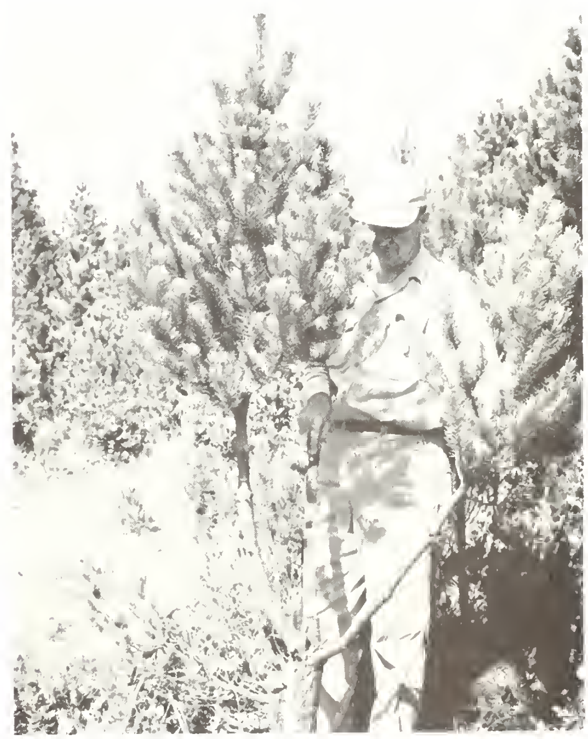
"Christmas Tree Harvesting and Marketing for Pacific Northwest Growers", Bernard S. Douglass, U.S. Forest Service, Region 6, Portland, Oregon, October 1964.

L. PLANNING THE NEXT CROP

Pines are normally harvested over a 3-year period. Stumps and cull trees are then plowed or bulldozed out and burned, the ground leveled, and a new plantation established.

Exceptions to clearcutting would be on a choose-and-cut operation where it is desirable to establish an uneven-aged or mixed species stand. This can be accomplished by annually planting a new seedling beside the stump of each tree that is harvested.

Stump culture, which is the practice of developing a new tree from a limb or sprout left on the stump, is seldom practiced on plantations. Most plantation growers prefer to rework the soil and start over with a new even-aged plantation. Stump culturing does have some application on sheared natural stands of pine, such as shore pines along the Pacific Coast and white pines in the southern Puget Sound area.



This stump culture was developed in a natural stand of shore pine near the Oregon Coast. The smaller branch (right) should be removed to make room for the large one (center).

M. CONCLUSION

Pine Christmas trees from Oregon and Washington have steady, although limited, demand. Superior pine characteristics, such as excellent needle retention, should contribute to their increasing popularity. Although competition from Eastern producing areas is increasing in the Southwest, demand continues strong for fresh, quality, sheared Northwest pines.

Shearing seasons and techniques for pines are considerably different from those for Douglas-fir and true firs. Pine shearing practices are not difficult, but require strict attention to the basic rules that are described in this bulletin. If shearing is delayed too long, improperly performed, or skipped for even one year after once being started, it is difficult or impossible to develop a quality tree.

N. SOURCES OF ASSISTANCE AND INFORMATION

Services of a farm forester are available to most woodland areas in Oregon and Washington. The office address of the local farm forester can be obtained from any State Forestry Department Office in Oregon or State Department of Natural Resources Office in Washington.

Reference material is available from the County Extension Agent. He can also advise growers of availability of assistance from farm foresters, extension foresters, and others who work with Christmas tree growers.

Additional sources of Christmas tree culturing information are:

Extension Forestry Specialist
Forest Research Laboratory
Oregon State University
Corvallis, Oregon 97331

Extension Forestry Specialist
Cooperative Extension Service
Washington State University
Johnson Hall 317-A
Pullman, Washington 99163

Extension Forestry Specialist
Cooperative Extension Service
Western Washington Research and Extension Center
Puyallup, Washington 98371

Local offices of the Soil Conservation Service

Special Products Forester
Division of State & Private Forestry
U. S. Forest Service
P. O. Box 3623
Portland, Oregon 97208

Northwest Christmas Tree Association (The name and address of the current secretary may be obtained by contacting any of the other sources of information.)

GPO 994-434

MANAGING YOUR WOODLAND

HOW TO DO IT GUIDES

PACIFIC NORTHWEST REGION—STATE AND PRIVATE FORESTRY

PORTLAND, OREGON

o. 14 May 1966

DEVELOPMENT OF A PLANTATION OF HIGH QUALITY TRUE FIR CHRISTMAS TREES

CONTENTS Page

repared by Bernard S. Douglass, U. S. orest Service, Division of State and rivate Forestry, and Gary H. Sander, xtension Forester, Oregon State niversity, with guidance and assistance f: Oregon State Board of Forestry; Wash. epartment of Natural Resources; Oregon Washington Extension Services; U. S. oil Conservation Service; Forest School aculties of Oregon State University; niversity of Washington, and Washington tate University; and member growers orthwest Christmas Tree Association.

FOR FURTHER INFORMATION CONSULT YOUR LOCAL FORESTER

DEVELOPMENT OF A PLANTATION OF HIGH QUALITY TRUE FIR CHRISTMAS TREES

. INTRODUCTION

l1 native species of true firs (genus Abies) are used for Christmas trees. Some re used to a much greater extent than others, as shown in the following tabulation f trees harvested in 1964:

Christmas Tree Species	Oregon		Washington	
True firs	Number	Percent	Number	Percent
Noble fir	124,000	18.0	12,800	0.5
Concolor fir	78,000	11.0	200	*
Grand fir	39,000	5.0	15,300	0.6
Shasta red fir	4,000	0.5	200	*
Silver fir	3,000	0.4	12,000	0.5
Alpine fir	1,000	0.1	500	*
Total (True Firs)	249,000	35.0	41,000	1.6
Other Species	461,000	65.0	2,409,000	98.4
Total (All Species)	710,000	100.0	2,450,000	100.0

*Less than 0.1%

rue firs have several natural advan-ages for Christmas trees:

1. Their natural beauty as hristmas trees is generally considered nsurpassed.

2. They have strong, sturdy ranches that hold their shape.

3. Most true firs retain their eedles and freshness.

4. They bring the highest market rices.

True firs also have several natural disadvantages:

1. They are less adaptable to various climates, exposures, and soils.

2. They develop slower than Douglas-fir and pines, especially during first 3 or 4 years after planting.

3. Insects, diseases, and climatic injuries may be troublesome.

4. They are difficult to control for proper growth rates.

5. They fail to respond as well to shearing as Douglas-firs and pines.

ore than 90% of true fir Christmas tree production was from natural stands in 1964. owever, the acreage of plantation true firs has increased rapidly in recent years. his trend is expected to continue.

elatively few growers, to date, have produced high quality marketable true fir hristmas trees on plantations. Frequent failures have been caused by poor election of plantation sites, inadequate site preparation for planting, poor choice f species and seed origins, too small planting stock, and unskilled cultural ractices.

The purpose of this bulletin is to help growers avoid some of the pitfalls that have caused past failures. At the same time, it will point out conditions and practices that have produced high quality trees on the relatively few successful true fir plantations.

B. RECOMMENDED TRUE FIR SPECIES

Six species of true fir are natives of the Pacific Northwest. Some 40 other species are widely scattered through North and Central America, Europe, Asia, and North Africa. The best prospects for Christmas tree plantations in Oregon and Washington are four of the native species: noble fir (Abies procera), Shasta red fir (Abies magnifica) grand fir (Abies grandis), and concolor or white fir (Abies concolor).

Silver fir has never done well on lowland plantations. Alpine fir seedlings are difficult to procure and need further testing.

Too little is known about the exotic species to recommend planting them except on a limited trial basis.

Noble and Shasta red firs will be grouped together for this discussion because their appearance, cultural responses, and site preferences are quite similar. Concolor and grand fir will be grouped together for the same reasons.

1. Noble and Shasta Red Firs. Noble and Shasta red firs grow naturally at 2,500- to 5,000-foot elevations.

Branch and needle structure is stiff and strong to withstand heavy snows in their natural habitat. They have characteristic well-branched whorls with rather short internodal branches and open internodal spaces between. Their greatest beauty is stately appearance provided by a formal uniform branching habit. They are easily decorated with pendulant type Christmas tree ornaments, such as colored glass balls and tinsel. They are also adaptable to flocking with artificial snow.

Noble fir is a native of the high Cascades and Coast Ranges from northern Washington to southern Oregon. Shasta red fir is a native of the high Cascades and Siskiyou Mountains of southern Oregon and northern California Shasta red fir is known as the "silvert on the California Christmas tree market

Both species have produced beautiful, desirable plantation-grown Christmas trees when grown on suitable sites and properly cultured. Needle retention and durability during storage and shipping is outstanding. Their appearance is quite similar. Where one species grows well the other is also likely to succeed. Noble fir usually grows slightly faster than Shasta red fir, bu Shasta red fir is somewhat more toleran of dry soil conditions. Growers with suitable planting sites should, perhaps try both species and give future prefer ence to the one that responds best.

Noble and Shasta red fir are very parti ular about their growing site. They prefer level to gentle northerly and easterly slopes where soil is rich in humus, moist and well drained. They do not tolerate heavy compacted clay soil, heavy grass sod, or frost pockets. Cool moist conditions preferred by thes species do not imply overhead shade. Like all other Christmas tree species, they develop best under open sunlight without root competition from larger trees, brush, grass, and weeds.

2. Concolor and Grand Firs. Concolor fir grows naturally on level to northerly and easterly exposures in the mountains of southeastern Oregon. Its range extends down the west slopes of the Cascades to a limited extent in southern Oregon. It also has a wide range outside the Pacific Northwest in California, the central and southern Rockies, and Mexico.

rand fir grows naturally in western nd eastern Washington, and western and ortheastern Oregon at many elevations. t is also found in southern British olumbia, northwestern California, southrn Idaho, and western Montana. Concolor ir and grand fir, like Douglas-fir, ave many inherited variations over heir wide geographic ranges. These nclude differences in growth rate, isease resistance, color, needle retenion, and many other characteristics hat are important to Christmas tree rowers. For example, the needles of he southern Rocky Mountain strains of oncolor usually have a blue-green tint nd relatively good retention when the rees are cut. Trees of Oregon and alifornia strains are lighter green nd sometimes have a problem of shedding eedles. Also, west side strains of rand fir usually have needles arranged n two single flat rows on the twig. any east side strains have two double ows on each twig and the needles sometimes spread upward somewhat like noble ir.

oth concolor and grand fir produce eautiful Christmas trees. They are sually priced on the Christmas tree arket between noble fir and Douglas-fir. oncolor fir generally has a somewhat ushier appearance than grand fir because its needles are longer and point ut in many directions from the twig.

ome west side plantations of concolor nd grand fir have become heavily nfected by rusts and other foliar disases in recent years. Resulting disolorations and shedding of needles have urt their value for Christmas trees. ome plantation managers have become iscouraged from further planting of hese species or have switched over to oble and Shasta red firs. Other west ide growers have apparently found a avorable combination of site and seed ource to produce vigorous, well-formed, isease-resistant trees. Research is eing carried out for concolor and rand fir Christmas,trees particularly he relationship of seed origins to tree uality and disease resistance.

Meanwhile, west side growers are advised to establish these species sparingly on each planting area and carefully observe their growth, form, and disease resistance before attempting larger plantings.

C. MATCHING SPECIES TO SITE

The high elevation true firs, noble and Shasta, require more moisture and cooler growing conditions than grand fir, concolor fir, Douglas-fir and pines. At the same time, they require good drainage. Best growth response in plantations is usually obtained on level to gently sloping northerly to easterly exposures where the soil is well drained but not subject to severe summer heat and drought. However, their ability to survive on southerly and westerly exposures improves where summer rainfall is heavy and summer temperatures are moderate. This may explain why noble fir and Shasta red fir usually respond best when planted at higher elevation plantations that approach their natural range. Experience has shown that their chances for survival and growth response are likely to be better on a foothill field at 1,500-foot elevation than on a lowland field only a few miles away.

Concolor and grand firs require greater summer moisture and coolness than Douglas-fir or pine. However, they are less demanding in this respect than noble fir and Shasta red fir. They appear to respond equally well on high or low elevation plantations, but prefer cooler,moister sites. Level to gently sloping northerly and easterly exposures are usually most favorable in these respects for low elevation plantations.

Christmas tree growers sometimes have several site conditions on a single planting area. For example, a ridge running east and west through a field contains both north and south exposures. The north exposure is usually the best choice for planting true fir Christmas trees, but usually the poorest for Douglas-firs and pines. A good topographical planning map will help the grower decide the best species to plant on each portion of his planting area.

Opportunities to establish true fir plantations east of the Cascades are limited by excessive heat and dryness. Grand fir and concolor fir are the most reliable east side true fir species. Best chances for survival are on northerly to easterly exposures where these species grow, or once grew, naturally. Planting moisture-loving species such as noble fir and Shasta fir on dry east side sites is a waste of time and money.

D. PLANTING

Planted true fir seedlings require sunlight and adequate moisture. They should always be planted on bare, freshly cultivated ground. Fields infested with quack grass, Canada thistle, or bracken fern should be avoided until these have been eliminated. Rank growth of grass and weeds during the spring and summer months will shade and distort the newly planted seedlings and deplete moisture in the soil. Old fields with heavy sod or weed cover should be disked as often as necessary during the summer to control grass and weeds; then disked and harrowed during the following spring just before planting. This will cause sod and other heavy organic matter to break down and decay. It will also eliminate new growth from seeds and root sprouts.

Three- or four-year-old true fir planting stock (2-1, 3-0, 3-1, or 2-2) is recommended. Its extra cost over two-year-old seedlings is justified by more rapid development and decreased first year's mortality in the plantation. Any runty or weak seedlings should be sorted out before planting. These can be developed into vigorous seedlings in a transplant bed. They provide a handy source of seedlings to replace mortality in the field. Transplant beds may also be used to develop 2-0 seedlings to larger stock for next year's planting.

Planting stock is packed in tight bundles or packed in waterproof bags at the nursery for convenience during shipment. Wet shingle tow, moss, or other absorbent material is placed around the roots to protect them from drying. Water should be poured through both end of bundles as soon as they arrive to replenish water lost during shipment. Bundles should be stored outdoors in a cool, protected spot. Unless trees are planted within about a week after delivery, they should be removed from the bundle and heeled in where there is sufficient moisture, shade, and protection from drying winds.

Planting, whether by hand or machine, requires special techniques for good survival. A farm forester or other local forester should be consulted.

Whether to spring plant or fall plant depends on when planting stock is available and frost heaving conditions, which may occur when trees are fall planted on heavy clay-loam soils. Consult your local forester.

A 5x5 foot spacing is commonly used for producing true fir Christmas trees 5 to 7 feet tall. Some growers prefer somewhat wider spacing--5¼'x5¼' or 5½'x5½'--to permit easier operation of their equipment between the rows or to provide more open sunlight around the lower branches.

Perfect spacing of trees to form check rows in each direction has the advantag of permitting cultivation and mowing in two directions. However, many growers do not believe the additional cost of check row planting is justified. They prefer, instead, to space the trees randomly in straight rows, and rely on chemicals to control grass and weeds. When check rowing is the preferred method, it can be accomplished by premarking the cultivated field in squares or hand planting along a wire marked at proper intervals. Machine planting is much faster and somewhat less costly than hand planting, but few operators have acquired sufficient skill to plant accurate check rows.

oadways are needed through the plantaion to provide access and fire protecion. These can be provided by skipping he planting of two adjacent rows of rees at intervals of every 20 to 30 ows.

. WEED AND GRASS CONTROL

rue fir Christmas tree plantations hould be kept free of heavy grass and eeds. This is especially important or survival and growth during the first hree or four years after planting. eed and grass competition harms the rees in three ways:

1. It forms a canopy of shade that uppresses and deforms the trees. rees need open sunlight for adequate rowth and attractive needles.

2. It depletes moisture and nitroen from the soil. True firs require dequate summer moisture and nitrogen or good growth, color, and survival.

3. It provides a habitat for eadow mice, gophers, rabbits, and other estructive rodents.

requent cultivation for the first three r four years after planting was, until ecent years, the best known practice or controlling grass and weeds. hemical herbicides, particularly atraine, are now rapidly replacing cultiation for doing this job. They usually rove less costly, more effective, and onger lasting than cultivation. Moreover, they permit vegetation control round the base of the trees where ultivation is difficult.

trazine is available in either dry ranular form or as a wettable powder. he wettable form is least costly. Both orms are effective as a combination re-emergent (kills grass and weed prouts as they germinate), and postmergent (kills existing cover of grass nd weeds). However, it is relatively neffective for bracken fern, Canada histle, and other deep-rooted vegetation. It should be applied uniformly over newly planted areas in February or March before new sprouts have emerged. It should be re-applied at the same season about every two years, or whenever grass and weeds become re-established. Atrazine can be applied directly over dormant trees, even those that are newly planted, without causing damage. In fact, trees metabolize this chemical and actually show improved color and growth after its application.

Usual rates of applications are about three pounds per acre (actual) on sandy or gravelly soils and about four pounds per acre on heavier clay-loam soils. The granular form is usually applied by hand spreading or with power blowers; the wettable form by aerial spraying, boom sprayers with agitators, or hand sprayers on small areas. Some growers save chemicals by spot-treating three-foot circles around individual trees; then mowing the intervening grass strips. However, broadcasting the entire area will usually save time and money in the long run. Detailed instructions for use of herbicides should be obtained from your local farm forester or county agent.

Mowing, chemicals, or a combination of mowing and chemicals, is the usual method of weed and grass control after the third or fourth growing season. If continual cultivation is the preferred method, the equipment must be small enough and the bottom tree whorls developed high enough above the ground to prevent mechanical injuries to the branches.

F. INSECT AND DISEASE CONTROL

1. Insects have not been particularly troublesome on most true fir Christmas tree plantations. However, balsam wooley and other aphids, budworms, needle miners, and sawflies are all potential problems. It is more effective and less costly to spray with insecticides at the very first outbreak than to wait until the plantation is badly infected.

White grubs of the June beetle sometimes devour roots of seedlings planted in old fields. An effective preventative treatment is to starve out the white grubs by clean cultivating the field for a year before planting.

County agents, farm foresters, and forest entomologists can help to identify insects and recommend effective insecticide treatments.

2. Diseases have been a serious problem on many west side true fir plantations, particularly on grand fir and concolor fir. Most serious are several types of true fir needle rusts, which cause spore blisters on the undersides of the needles, followed by browning and shedding from the twig. The most serious rust, Uredinopsis pteridis, alternately infects bracken fern. Huckleberry is an alternate host for another common species of true fir needle rust.

The first indication of needle rust is white spore blisters on the under sides of the needles in spring and summer.

Two species of true fir needle cast fungii may cause black lines and spots on the needles, followed by browning and shedding.

Rust infection is followed by browning and shedding of needles during late summer and fall.

County agents, farm foresters, and forest pathologists can help to identif[y] tree diseases and recommend effective fungicide treatments. Like insects, diseases are easiest to stamp out in their earlier stages before they gain a foothold.

G. DESCRIPTIONS OF CULTURAL PRACTICES

Several effective cultural practices fo[r] controlling growth and improving qualit[y] of true firs will be described in this section.

Excessive leader growth can be controll[ed] by shock treatments such as basal pruni[ng,] basal scarring, and root pruning. Growers should strive to hold annual leader growth to 10" - 14" by using one or mor[e] of these methods when needed. Trees th[at] grow faster than this will have a spindl[y] appearance caused by widely spaced bran[ch] whorls. However, trees should be shock[ed] only enough to accomplish the desired slowing of growth. Overshocked trees become stunted and may develop unthrift[y] needles. Unlike pines, which the grower can shear each year to any desired shap[e,] true firs require "good guessing" on th[e] part of the grower as to the correct

egree of shocking. Experienced growers evelop an almost uncanny ability to rejudge the amount of shock required o hold growth to the desired rate. heir principal indicator is the growth ate during the past two years. For xample, if a noble fir grew 10 inches wo years ago, and 14 inches last year t is almost certain that it may grow 8 inches or more the next year. The ree should be shocked to prevent this xcessive growth. On the other hand, f a tree has been growing uniformly at 2 inches per year for the past several ears, it is less likely to make a udden and spectacular gain during the ext growing season.

ome trees will "get away" by developing xcessively long leaders despite preventtive shock treatments. The trees should e restored to proper proportion by eader pruning and side shearing. These reatments will usually produce a marketble tree that would otherwise be a cull. owever, true firs that have been leader runed and sheared are usually not as igh in quality as unsheared trees with dequate whorl spacing.

dditional cultural practices will be escribed for replacing lost leaders, eveloping new trees from a stump, and ertilizing to improve quality. Growers hould not be surprised that each tree n their plantations shows somewhat ifferent growth habits. Each tree hould be cultured individually to bring ut its best qualities. Some trees may evelop into premium quality by only asal pruning. Others, growing on the ame site, may require a number of ifferent cultural treatments to make hem marketable. A few trees will fail o shape up regardless of how skillfully hey are cultured. In the long run,each lantation manager must go through a rocess of trial and error and adopt the ultural practices that produce the ighest quality for him.

1. Basal Pruning. Locate a good bottom whorl with at least four, and preferably 5 or more strong, evenly spaced branches. This bottom whorl should not be lower on the stem than 13 - 15 inches above the ground. This minimum height permits an adequate handle plus several additional inches of stem below the handle for scarring and possibly stump culturing. In practice, the bottom whorl of many trees will be located more than 15" above the ground. This may be necessary to find a good bottom whorl, locate a straight stem for the handle, or develop the lower branches above heavy shade caused by grass and weeds. Basal pruning should eventually remove all unwanted branches below the bottom whorl. They should be cut flush with the bark. If stump culture is planned, a few branches should be retained below the base of the handle near the ground to keep the stump alive after the tree is cut. Basal pruning can be done any time of the year except early summer at which time tender new growth is easily damaged during culturing.

Basal pruning retards tree growth by shocking the tree. A growth control study for noble fir 1/shows height growth retardation of 21% during the first growing season after removing 50% of the live branches by basal pruning. Growth retardation was even more--25%--during the second growing season, and continued to a lesser degree into the third growing season after treatment. Thus, basal pruning can be used as an effective shock treatment to help prevent future excessive leader growth. At the same time, excessive shock from overpruning should be avoided by deferring basal pruning until such time that it appears that next season's growth would likely exceed 12" unless the tree is shocked.

1/Study made in Clackamas County, Oregon, by Bernard Douglass, Alvin Parker, layton Wills, and Harry Roundsfell 1961 - 1963.

This grand fir grades below U.S. No. 2 because of excessive whorl spacing. Basal pruning to reduce growth rate could have resulted in a U.S. Premium or U.S. No. 1.

Basal pruning is one of the most useful cultural practices. It is used to shock the tree to prevent excessive future growth. It also forms a handle under a strong, uniform whorl to become the base of the planned tree.

This noble fir is not ready for basal pruning. Annual growth is less than 12" per year. Premature shocking would cause further stunting and delay its harvest by several years.

This noble fir is ready for basal pruning as indicated by the 14" leader. If the tree is not shocked at this time, next year's leader is likely to grow excessively long.

Basal pruning during the previous year effectively controlled growth of this noble fir. Had the tree not been shocked, indications are that that the leader would have been about 18" long instead of 13".

2. Shearing. Shearing consists f removing unwanted tips of individual ateral branches to improve symmetry, aper, and density. Shearing is not ecommended for true firs that shape up ell naturally. Most customers prefer rue firs that appear natural and unheared with uniformly spaced whorls, ymmetric shape, and moderate density. rowers should endeavor to produce such rees by controlling the growth rate of aturally shaped trees, rather than by orrecting trees after they have already ade excessive growth.

owever, many true firs will need shearng in spite of growth control measures ecause of excessive leader growth, lopidedness, faulty cone shape, or loss of eader buds. Many unmarketable type rees can be restored by timely shearing.

he only type of shearing recommended or noble fir and Shasta red fir is fork shearing". This consists of removing tips of individual lateral branches with a hand pruner just above a fork in the branch formed by oppositely arranged secondary branches. Sufficient branch tip should be removed to attain desired tree width and uniform cone-shape. Fork shearing does not cause noticeable stubs and it develops symmetrically formed branch tips. Several years' growth may need to be removed from excessively wide trees to restore a normal taper. One disadvantage of fork shearing should be recognized. Heavy snowfall or rough handling may cause limb breakage at the point of the forks.

Fork shearing removes individual lateral branch tips to improve shape and prevent excessively wide trees. New growth from secondary branches is symmetrical and fan-shaped.

Grand fir and concolor fir are sometimes random sheared with a shearing knife or hedge shears, rather than fork sheared, to improve density, shape or taper. The best season to random shear is July or August before the new growth has hardened off completely. However, fork shearing is the preferred method because it leaves the branch tips more natural in appearance.

3. Disbudding is accomplished by pinching off the terminal, or middle bud, from the bud cluster at the tip of main lateral branches. Branch growth resulting from disbudding is similar to that of fork shearing. It prevents growth of the main branch tip and allows two or more secondary branches to develop instead. Disbudding is used for the same purpose as fork shearing but is considered a less drastic treatment. A combination of disbudding and fork shearing is frequently used for the same tree when some branch tips require greater shortening than others.

An excessively long concolor fir leader was pruned to proper length a year ago. Pointed out is a typical "dogleg" where an internodal bud just below the cut formed a new leader.

4. Leader Pruning is done to cut back excessively long leaders to proper length. Like shearing, leader pruning of true firs is recommended only as a last resort when natural growth is excessive or lacks adequate density. Ideal annual leader growth for true firs is about 12". However, it is usually better to retain natural leaders up to about 15" in length than to correct them by pruning back. Reason: The base of the new leader arising from the top bud of a pruned leader usually forms an unsightly crook called a "dogleg". Also the terminal bud set of this new leader frequently contains only three buds which produce a branch-like whorl. These leader pruning difficulties occur for all species of true firs, but are especially pronounced on noble and Shasta red firs. The difficulties can be minimized by leader pruning during midsummer when new growth is just completed, rather than during the dormant season. This timing allows the terminal bud to become more erect and better adjusted to produce adequate terminal buds the following year.

Pruning excessive leader growth frequently results in poor branch formation. This noble fir top shows this tendency with a one-sided branch arrangement and only 3 branches in the top whorl. Better results can be obtained by controlling natural growth to prevent excessive leader lengths.

Detailed instructions for leader pruning are as follows: Locate a cluster of internodal buds on the leader about

10" - 14" above its base. Locate a strong internodal bud 2" - 4" above the cluster and cut the leader on a 45° slant about ¼" above it. Any additional buds between the cluster and the top bud should be picked off to discourage formation of multiple leaders.

At the same time, it is always necessary to cut back the branch tips of the top whorl just above a pair of buds or a single bud on the bottom side of the branch. Pick off any bud from the <u>top side</u> of a branch within 1" of its sheared tip. Top buds form unsightly "in pointing" branches. Shearing back the branches of the top whorl prevents them from turning up and forming multiple leaders. It also keeps their length proportional to that of the pruned leader. When the leader and top whorl are pruned, it is usually necessary to shear the rest of the tree as well to restore a uniform taper and prevent excessive tree width.

Multiple leaders formed on the pruned top of this grand fir. They were caused by leaving 3 internodal buds, rather than one just below the cut. It is being corrected by removing all of the leaders except the one with the best bud set.

Leader pruning, together with fork shearing and disbudding, increases the density of light, open branched trees. It forces internodal branches to fill in wide growth intervals between whorls, known as "goosenecks".

New leaders arising from internodal buds of pruned noble fir and Shasta red fir leaders are frequently reluctant to turn up straight. A splint or wire is needed to straighten the noble fir leader shown above.

Next year's leaders, arising from the top buds of a pruned leader, do not always grow straight and erect, and may require leader training. An effective method is to make a loose spiral around the bent leader with a 12" - 16" piece of #8 to #13 gauge (depending on leader stiffness) aluminum wire. This permits bending the leader to any desired position. Best season to train leaders is late July and early August when new growth has sufficiently hardened off to resist injury by the wire. The wired leaders will set permanently after about 30 days for grand fir and concolor fir and after about 60 days for noble fir and Shasta red fir. In any event, the wire straightener must be removed before the next growing season to prevent strangulation.

5. Replacing Lost Leaders. Aborting of the center leader bud or mechanical injuries may cause true firs to lose their leaders. When this happens, several branches of the top whorl may turn upward and form multiple leaders. Needless to say, this spoils the symmetrical appearance of the tree.

Caution: Sometimes regrowth (lammas growth) will occur from the terminal bud cluster of a leader in late summer. This causes short branchlets instead of normal buds. Frequently, in this case, the lateral buds of the terminal cluster will elongate, but not the center bud. This makes the center bud appear to be dead. Actually, it is usually alive, and will catch up with the laterals next growing season and make a normal leader.

The center bud of this noble fir aborted leaving a top whorl without a leader. It can be corrected as follows: Select a strong branch in the top whorl. Bend it upward to a vertical position and hold in place with a splint or wire straightener. Cut back the remaining branches in the top whorl to restore good proportion and to prevent them from forming multiple leaders.

A lateral branch can be trained to replace a lost leader by prompt treatment, preferably in late July or August. A strong, closely spaced lateral branch in the top whorl should be selected for the new leader. It should be bent to a vertical position and held in place with a loose spiral wrapping of aluminum wire or by a splint. When wire is used to train a lateral branch it will need to stay on the tree 2 or 3 months before the branch "sets" in a vertical position and the wire can be removed. At the same time, the tips of the other top whorl branches should be cut back to approximately half the length of the new leader to prevent them from turning up, assure dominance of the new leader, and restore good proportion to the tree.

Sometimes the entire terminal rosette of leader buds aborts or is broken off. In this case the leader should be pruned back as described in (4) on page 11.

6. Basal Scarring. Basal scarring is accomplished by skinning off a strip of bark about 4" long from the base of a tree to produce shock and slow its future growth. The scar should always be made 9" or more below the bottom whorl to avoid disfiguring the handle. Therefore, sufficient stem length below the bottom whorl should be allowed for scarring, as well as for forming a handle.

Scarring should not be done unless exces-sive growth threatens to become a proble Its principal purpose is to reduce the growth rate of trees that have recovere from the retarding effects of basal prun-ing. Scarring is sometimes combined wit basal pruning on fast growing trees whe growth would not be sufficiently retarde by basal pruning alone.

Light scarring girdles about 1/3 of the stem circumference and heavy scarring girdles a maximum of 3/4. The more severe the scarring, the more pronounce will be next year's growth reduction. Scarring should be only as deep as the cambium layer. Cutting into the wood weakens the stem and does not appreciably increase shock.

Basal scarring is accomplished by removing strips of bark from the main stem below the handle. It is used to further slow the growth rate when basal pruning will not provide the desired degree of shock.

Growth control experiments on noble fir[1] (footnote page 8) produced 30% reduction of next year's growth by combining 50% scarring and basal pruning to remove half of the live branches. Basal pruning without the scarring reduced next year's growth only 21%.

Growth control experiments on grand fir[2] produced 16% reduction of next year's growth by 50% scarring alone. However, the shock wore off and growth reverted to normal during the second year.

7. Root Pruning. Root pruning is accomplished by cutting a portion of the surface roots of a tree to produce shock and slow growth. Roots are normally cut about 2/3 the distance from the stem to the drip line at a soil depth of about 8". Root pruning should normally be done only on one side or two opposite sides of the tree. A complete circular cut entirely around the stem overshocks the tree and causes yellowing of the needles for at least one year.

A grand fir is being root pruned by cutting the surface roots on two sides of the stem with a sharpened shovel. This tree grew excessively in spite of previous basal pruning and basal scarring. Additional shock is provided to slow future growth.

Root pruning is not normally done unless excessive growth threatens to become a problem despite previous basal pruning and scarring. It is usually reserved as a last resort shock treatment when all other treatments have failed to retard growth sufficiently.

Growth control experiments on grand fir[1] (footnote page 8) produced 60% reduction of next year's growth by cutting a circle in the soil entirely around the stem the depth of the shovel blade and 2/3 of the distance from the stem to the drip line. The second year's growth rate reduction was even greater--about 70%.

2/ Study made in Clark County, Washington, by Fred Pratt, James Gibbons, and Bernard Douglass 1960 - 1962.

Growth control experiments on noble fir[1/] (footnote page 8) produced 27% reduction of next year's growth by a less drastic type of root pruning combined with basal pruning to remove half the live branches. Root pruning, in this instance, was by parallel cuts on two sides of the tree the depth of a shovel blade and 2/3 the distance from the stem to the drip line. Growth reduction the second year increased to 36%, but the third year reduction of only 21% indicated recovery from the shock.

8. Stump Culture. Stump culture is the practice of developing a new tree from a small limb or sprout on the stump after a Christmas tree is cut. A year or two after the tree is cut, the sprouts will turn upward and form multiple leaders. The most promising one is then selected to produce a new tree.

Stump culturing is recommended where planted trees are difficult to establish and the established root system of the cut tree will reduce the rotation age of the next crop of trees. It also permits establishment of an uneven aged Christmas tree plantation where Christmas trees may be harvested off the same area year after year.

True firs are reluctant to form a new tree from an upturned branch. Much better results for this species are obtained by developing a newly formed stump sprout.

Sprouting can be encouraged by lopping off the tips of the live branches left on the stump. The only purpose of these branches is to sustain the vigor of the root system until a sprout is produced. A good rule of thumb on the amount of branches necessary to leave on the stump to keep the root system alive is at least 10% of the total live crown of the tree.

The best time to select branches on the lower stem for stump culturing is when the trees are being basal pruned.

Normally, only a partially suppressed whorl next to the ground need be retained. Branches in this whorl will develop greater size and vigor during the period that the Christmas tree is growing to marketable size. It may even be necessary to cut their tips back if they interfere with mowing or cultivating, or grow upward into the lower whorl of the Christmas tree. Sometimes vertical adventitious sprouts form below the handle a year or two before the Christmas tree is harvested. These should be encouraged because they will give the new stump-cultured tree a year or two head start.

9. Fertilizing. Most cleared lands, formerly under cultivation, contain sufficient nutriments for good Christmas tree vigor and color without fertilizing. However, exceptions may occur causing needles to remain chlorotic (yellowish) or growth rates to remain inadequate despite grass and weed control.

Fertilizers must be used with caution. Overdoses may injure the roots, cause excessive growth, or stimulate rank growth of grass and weeds. Experimental applications of 1/16 - 1/4 lb., (actual nitrogen) per 6-foot tree should be made to determine the least amount per tree needed to obtain desirable color and vigor.

Large scale applications should not be made until sufficient small trials have proven the effectiveness under local conditions.

Straight nitrogen fertilizers have proven more effective and less costly than balanced fertilizers. Commonly used nitrogen fertilizers are urea, ammonium nitrate and ammonium sulphate.

Fertilizer should be scattered evenly under the drip line of the tree in late winter or early spring before the buds have burst. Proper amounts of nitrogen will cause heavy dark green needles after the first growing season.

Increased growth will be only slight during the first growing season but may double during the second and third growing seasons. Therefore, the safest time to apply nitrogen is in the same year that the tree will be harvested. Also, the needle color improvement from using nitrogen begins to drop off during the second growing season after application.

Another use of nitrogen is for stimulating vigor and growth of stunted or unthrifty trees on poor sites. Two precautions should be observed in fertilizing younger plantations.

1. Do not fertilize the same year that trees are planted. Roots at this time are easily damaged by even small applications of nitrogen.

2. Use nitrogen sparingly on small trees. Overdoses will burn the roots. Trial applications should be made around the drip lines of a few trees to determine the correct amount to stimulate adequate growth.

H. NUMBER OF YEARS REQUIRED TO GROW A MERCHANTABLE TREE

Rotations for growing true fir Christmas trees will vary with species, site, and intensity of culture. Harvesting is usually carried over a period of three years because all trees do not develop uniformly.

The rotation ages shown below are considered average for intensively managed plantations on Site III lands. The percentage of total cut for each year of an assumed three-year harvesting period is shown.

I. STEP-BY-STEP CULTURAL INSTRUCTIONS

1. After First Growing Season. Concentrate only on keeping trees alive, healthy and growing.

The only pruning would be removing double leaders. The choice of multiple leaders to save should be based on its vigor, erectness, number of internodal buds, and completeness of terminal buds.

Weed and grass control is essential for good survival.

Watering during prolonged summer drought periods may make the difference between good and poor survival.

The first summer's mortality should be replaced during the regular planting season with the same species originally planted. Replacement stock can be developed in a transplant bed, wherein 5 - 10% of the original planting stock is held.

2. After Second Growing Season. Same instructions as for "After First Growing Season".

True firs develop slowly and are unlikely to require pruning at this time.

When herbicides are used to control grass and weeds, they should be effective through the second growing season. When cultivation is the chosen method, it should be repeated as often as necessary to leave the ground clean.

Supplementary watering may be continued if necessary. However, it is less

Percentages of Trees Harvested at Various Plantation Ages

Species	Number of Growing Seasons: 7	8	9	10	11	Total
	Percent of Total Harvest					
Grand fir	20	40	40			100
Concolor		10	40	50		100
Noble fir		5	45	50		100
Shasta red fir			5	45	50	100

important than during the first year because the roots are becoming established.

Mortality may be replaced from the transplant bed or other sources with trees approximately the same size as those in the plantation. However, persistent mortality spots caused by shallow bedrock sterile soil, or poor drainage, should be replanted to Douglas-fir, shore pine, or some other more tolerant species. Replantings of true firs would likely die for the same reason that the original planting failed.

3. After Third Growing Season. Weed and grass control should continue. When herbicides are the chosen method, they should be re-applied at the original rates in February or early March.

Most seedlings will not require pruning except for removing multiple leaders. A few exceptionally fast growers may have developed leaders 12" or slightly longer. These may be basal pruned to prevent excessive next year's growth and start a handle. However, in order to prevent overshock and stunting, not more than 1/3 of their live branches should be removed at this time. Trees should be well enough established to discontinue watering.

4. After Fourth Growing Season and Thereafter Until Trees Are Harvested. Weed and grass control, if by herbicides, should continue every second year. Weed and grass control if formerly by cultivation, should now be replaced by mowing, herbicides, or a combination of mowing between the rows and herbicides under the drip lines. Do not basal prune trees when leaders are less than 12" long. They need their full crowns for adequate growth.

Basal prune, as described above under (3), when leaders are 12 - 15 inches long and no previous basal pruning has been done.

When leaders are 12 - 14 inches long, but trees were previously basal pruned, additional shock treatments are required as described below:

a. Complete the basal pruning to increase shock if this were only partially done the previous year.

b. Basal scar (about 50% scar) if complete basal pruning was accomplished during previous years.

When leaders exceed 14" long, they should be pruned back to 10 - 14" long. These leader pruned trees should also be shocked as follows to prevent future excessive growth:

a. Complete basal pruning, if this has not already been done.

b. Basal scar according to need. If leader growth is under 18" and basal pruning is being accomplished at the same time, a 33% scar is probably adequate. If leader growth exceeds 18" and basal pruning was accomplished during previous years, severe scarring up to 75%, should be considered. In extreme cases of excessive leader growth, further shock can be accomplished by root pruning. Remember that leader pruned trees require cutting back their top whorls and fork shearing, as a part of the same operation. Strive for a 50% to 65% crown taper. Taper is defined as the width of a tree expressed by a percentage of its height.

Fork shear any trees that require correction of lopsidedness, excessively wide taper, or imperfect cone-shape.

Fertilize the same year trees are harvested if needle color and vigor needs improvement.

J. CONCLUSION

True firs are in good demand and bring top market prices. Attractive needles, symmetrical branching, and durable foliage are selling advantages. At the same time, true firs are considered the most difficult species to produce in plantations.

Relatively few Northwest growers have produced high quality true fir plantations. The most successful growers have picked suitable planting sites. They have also cultured intensively to attain a cone-shaped tree with adequate density and proper whorl spacing.

Most successful growers try to produce as many natural-shaped, unsheared trees as possible. This type is in greatest demand. However, they practice leader pruning, disbudding, and side shearing to culture any trees with undesirable growth characteristics.

Annual leader growth of about 12 inches is desirable to produce good density in reasonably short rotations. The faster growing trees are shocked by means of basal pruning, basal scarring and root pruning. They are usually employed in the priority listed.

A number of other cultural treatments are also used, either singly or in combination, to improve the quality of plantation-grown trees. Some practices, such as weed,grass, insect, and disease control, may be applied uniformly over large plantation areas. However, most practices are applied according to the individual need of each tree being cultured.

Trial and error experience remains the most important process for developing a skilled grower. It can, however, be unnecessarily costly and time consuming. The purpose of this guide is to point out the pitfalls and successful techniques that have been learned by others over the years.

K. SOURCES OF ASSISTANCE AND INFORMATION

Services of a farm forester are available to most woodland areas in Oregon and Washington. The office address of the local farm forester can be obtained by inquiring at any State Forestry Department Office in Oregon or State Department of Natural Resources Office in Washington.

Reference material is available from the County Extension Agent. He can also advise growers concerning the availability of assistance from farm foresters, extension foresters and others who work with Christmas tree growers.

Additional sources of harvesting and marketing information are:

Extension Forestry Specialist
Cooperative Extension Service
Oregon State University
Forestry Building, 205
Corvallis, Oregon 97331

Extension Forestry Specialist
Cooperative Extension Service
College of Agriculture
Washington State University
Johnson Hall, 317-A
Pullman, Washington 99163

Extension Forestry Specialist
State Cooperative Extension Service
Western Washington Research and
Extension Center
Puyallup, Washington 98371

Local offices of the Soil Conservation Service

U. S. Forest Service
P.O. Box 3623
Portland, Oregon 97208

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DEVELOPING HIGH QUALITY TRUE FIR CHRISTMAS TREES

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A. INTRODUCTION

Production techniques for growing Christmas trees in the Pacific Northwest are constantly changing to meet consumer demands for higher quality. The main supply of all species of trees in the early days was uncultured, wild trees selected from cut-over lands. Beginning about 1950, most uncultured natural stands were gradually converted to managed stands by thinning and basal pruning. These cultural practices improved tree quality and, at the same time, increased production. Fertilizing and shearing have been added in recent years as further refinements.

Another significant trend since 1950 has been establishment of cultured plantations on agricultural lands. They already account for about 25% of total Pacific Northwest Christmas tree production, as compared with 60% from cultured natural stands and 15% for wild natural stands.

The true firs account for approximately 10% of Pacific Northwest production. This compares with about 83% for Douglas-fir and 7% for pines. However, the long-term prospects for true firs gaining a greater share of the market are favorable. The better species and strains have natural characteristics that appeal to the customer. Many new plantations of true fir have been established in the past 5 years.

All native species of true firs (*genus Abies*) are used for Christmas Trees. Some are used to a much greater extent than others, as shown in the following tabulation of trees harvested in the Pacific Northwest in 1969.

Christmas Tree Species	Oregon		Washington	
True firs	Number	Percent	Number	Percent
Noble fir	82,000	10.4	46,000	2.2
Concolor fir	73,000	9.3	2,000	*
Grand fir	20,000	2.5	33,000	1.6
Shasta red fir	4,000	0.5	2,000	*
Silver fir	1,500	0.2	5,000	0.2
Alpine fir	500	0.1	1,000	*
Total (True Firs)	181,000	23.0	89,000	4.2
Other Species	606,000	77.0	2,042,000	95.8
Total (All Species)	787,000	100.0	2,131,000	100.0

*Less than 0.1%

True firs have several natural advantages for Christmas trees:

1. Their natural beauty as Christmas trees is generally considered unsurpassed.

2. They have strong, sturdy branches.

3. Most true firs retain their needles and freshness after cutting.

4. They bring the highest market prices.

True firs also have several natural disadvantages to growers:

1. They are very particular as to site. Favorable climate, slope direction, air drainage, ground drainage, and soil type are essential for good survival and development.

2. They develop slower than Douglas-fir, especially during the first 3 or 4 years after planting.

3. Insects, diseases, or climatic injuries may be troublesome.

4. Uniform and desirable annual growth rates for true firs, other than grand fir, are difficult to maintain.

5. True firs, other than grand fir, are less responsive to heavy shearing than Douglas-firs and pines.

The latest survey of Pacific Northwest Christmas tree production showed that more than 70% of true fir Christmas tree production was harvested from natural stands in 1969. However, the acreage of plantation true firs has increased rapidly in recent years. The long-run trend is toward more plantation-grown trees and fewer natural-grown trees.

Growing high quality Christmas trees of any species requires a heavy investment of time, money, and knowledge. This statement applies particularly to true fir species, which are considered more difficult to develop than other species. Relatively few growers to date have produced large volumes of high quality marketable true fir Christmas trees on plantations. Frequent failures have been caused by poor selection of plantation sites, inadequate site preparation for planting, poor choice of species and seed origins, too small planting stock, inadequate grass and weed control, and unskilled cultural practices. However, a few growers have developed very profitable true fir plantations by selecting good growing sites and applying proper cultural practices skillfully. This bulletin will describe conditions and practices that have produced high quality trees on the relatively few successful true fir operations.

B. RECOMMENDED TRUE FIR SPECIES AND STRAINS

Six species of true fir are natives of the Pacific Northwest. Some 40 other true fir species are widely scattered through North and Central America, Europe, Asia and North Africa. The best prospects for Christmas tree plantations in Oregon and Washington are three of the native species: noble fir (*Abies procera*), Shasta red fir (*Abies magnifica*, var. *shastensis*) and grand fir (*Abies grandis*).

Although some concolor firs (*Abies concolor*) have been developed into attractive Christmas trees, they frequently suffer from terminal dieback, poor needle retention, frost damage and slow juvenile growth. Silver fir (*Abies amabilis*) and alpine fir (*Abies lasiocarpa*) have shown little potential on lowland plantations, and are not apt to play a significant role in future Christmas tree production.

Too little is known about the exotic species to recommend planting them except on a limited trial basis. Red fir (*Abies magnifica*) from the Sierra Nevada Mountains of California, Fraser fir (*Abies fraseri*) from the Southern Appalachian Mountains, Turkish fir (*Abies bornmuelleriana*), Nordmann Fir (*Abies nordmanniana*) from the high mountains in Asia Minor, and Spanish fir (*Abies pinsapo*) appear to be most promising of the non-native true firs.

Noble and Shasta red firs will be grouped together for this discussion because their appearance, cultural responses, and site preferences are quite similar.

1. **Noble and Shasta Red Firs.** Noble and Shasta red firs grow naturally at 2,000- to 5,000-foot elevations.

Branch and needle structure is stiff and strong to withstand heavy snows in their natural habitat. They have characteristic well-branched whorls with rather short internodal branches and open internodal spaces between. Their greatest assets are attractive, nonshedding needles and a stately appearance provided by a formal uniform branching habit. They are easily decorated with pendulous type Christmas tree ornaments, such as colored glass balls and tinsel. They are also adaptable to flocking with artificial snow.

Noble fir is a native of the high Cascades and Coast Ranges of Washington and Oregon. Its northern range is near Stevens Pass in the north-central Washington Cascades. Its southern range is the Umpqua River drainage in southern Oregon where it blends and hybridizes with Shasta red fir.

Shasta red fir is a native of the high Cascades and Siskiyou Mountains of southern Oregon and northern California. It is frequently lumped with California red fir under the name "silvertip" on the California Christmas tree market.

Both species have produced beautiful, desirable plantation-grown Christmas trees when grown on suitable sites and properly cultured. Needle retention and durability during storage and shipping is outstanding. Where one species grows well, the other is also likely to succeed. Noble fir usually grows slightly faster than Shasta red fir, but Shasta red fir is somewhat more tolerant of dry soil conditions. Needles of noble fir are generally considered somewhat more attractive than those of

Shasta red fir because they are darker green, stiffer, and more densily arranged on the twig. On the other hand, Shasta red fir develop a narrower, more "self-shaping" crown than noble fir. Growers with suitable planting sites should, perhaps, try both species and give future preference to the one that responds best.

A noble fir (left) is compared with a Shasta red fir (right) of the same age. Although these species are quite similar, the Shasta red fir is typically somewhat narrower, slower growing, more drought resistant, and about one week later in bud bursting.

Noble and Shasta red fir are very particular about their growing site. They prefer level to gentle northerly and easterly slopes where soil is rich in humus, moist and well drained. They do not tolerate heavy compacted clay soil, heavy grass sod, or frost pockets. Cool moist conditions preferred by these species do not imply overhead shade. Like all other Christmas tree species, they develop best under open sunlight without root competition from larger trees, brush, grass, and weeds.

Little is known at this time about the best seed origins of noble and Shasta red firs for Christmas tree production. We do know that several distinct strains occur over the natural ranges of these species, each with important differences in growth rate and appearance. Provenance tests are now underway in Oregon and Washington to determine best seed origins for Christmas trees.[1] The test trees should be ready to start evaluating in 1975.

2. **Grand Fir.** Grand fir grows naturally in western and eastern Washington, and western and northeastern Oregon at many elevations. It is also found in southern British Columbia, northwestern California, northern Idaho, and western Montana. Grand fir, like Douglas-fir, has many inherited variations over its wide geographic range. These racial differences include growth rate, disease resistance, needle retention, needle form, needle color and other characteristics that are important to Christmas tree growers. One example is the needle arrangement differences of west side and east side strains of grand fir. The west side strains usually have needles arranged in two single flat rows on the twig. Many east side strains have two double rows on each twig and the needles sometimes spread upward somwhat like noble fir.

Grand fir from suitable seed sources are beautiful Christmas trees. They are usually priced on the Christmas tree market between noble fir and sheared Douglas-fir.

Some west side plantations of grand fir become heavily infected by needle rust diseases during epidemic years, which seem to occur in 3- to 5-year cycles. Resulting discoloration and shedding of needles reduces their value for Christmas trees. Some plantation managers have become discouraged from further plantings and have switched over to noble and Shasta red firs. However, a few west side growers have found a favorable combination of site and seed source to provide vigorous, well-formed, disease-resistant trees.

Research is being carried out to determine best strains of grand fir for Christmas trees. A provenance test was established in 1968 to test and compare 24 grand fir strains from Oregon, Washington, California, Idaho and Montana.[2] Evaluations are based on vigor,

[1] Noble fir and Shasta red fir Christmas tree provenance tests for noble fir seed origins in Washington and noble fir and Shasta red fir seed origins in Oregon. Four outplantings were established in spring 1970 by the Division of State and Private Forestry, U.S. Forest Service, Portland, Oregon.

[2] Grand fir Christmas tree provenance tests for seed origins in Washington, Oregon, California, Idaho, and Montana. Four outplantings were established in spring, 1968, by the Division of State and Private Forestry, U.S. Forest Service, Portland, Oregon.

branch form, bud density, insect and disease resistance, needle form, and lateness in flushing. Results to date indicate that seed sources from the central panhandle area of northern Idaho produce the best plantation grown grand fir Christmas trees in western Oregon and western Washington.

C. MATCHING SPECIES TO SITE

The high elevation true firs, noble and Shasta red, require more moisture and cooler growing conditions than grand fir, Douglas-fir and pines. At the same time, they require moist but well-drained soils. Best growth response in plantations can generally be expected on gently sloping northerly to easterly exposures not subject to severe summer heat and drought. However, their ability to survive on southerly and westerly exposures improves where summer rainfall is heavy and summer temperatures are moderate. This may explain why noble fir and Shasta red fir frequently respond best when planted at higher elevation plantations that approach their natural range. Experience has shown that their chances for survival and growth response are likely to be better on a foothill field at 1,000-foot elevation than on a lowland field only a few miles away, assuming all other conditions are the same.

Grand fir require greater summer moisture and coolness than Douglas-fir or pine. However, they are less demanding in this respect than noble fir and Shasta red fir. They appear to respond equally well on high or low elevation plantations, but prefer cooler, moister sites. Level to gently sloping northerly and easterly exposures are usually most favorable for low elevation plantations.

Christmas tree growers sometimes have several site conditions on a single planting area. For example, a ridge running east and west through a field contains both north and south exposures. In this case, the north exposure is usually the best prospect for planting true fir Christmas trees, but not usually best for pines and Douglas-firs. A U.S. Geological Survey topographical quadrangle map is useful to determine direction and degree of slope for matching species to site.

Opportunities to establish true fir plantations east of the Cascades are limited by excessive heat and dryness. Grand fir is not recommended on drier east side sites. Its best chances for east side survival are on northerly to easterly exposures at higher elevations where these species grow, or once grew, naturally. Planting moisture-loving species such as noble fir and Shasta red fir on typical east side sites is a waste of time and money. Even if the trees are watered frequently, low humidity extremes and temperature extremes will cause poor growth and needle dieback.

D. PLANTING

True fir seedlings require sunlight and adequate moisture. They should always be planted on bare, freshly cultivated ground. Fields infested with blackberries, quack grass, Canada thistle, or bracken fern should be avoided until these have been controlled by chemicals or repeated cultivation. Rank growth of grass and weeds during the spring and summer months will shade and distort the newly planted seedlings and deplete moisture in the soil. Old fields with heavy sod or weed cover should be disked as often as necessary during the summer to control grass and weeds; then disked and harrowed during the

This spring-tooth cultivator is shredding old roots and loosening the soil in preparation for disking, harrowing, and tree planting. Several months previously, a heavy land clearing disk was used to uproot and pulverize the stumps from a previous crop of Christmas trees.

following spring just before planting. This will cause sod and other heavy organic matter to break down and decay. It will also eliminate new growth from seeds and root sprouts.

Fields formerly planted to strawberries or other row crops somtimes become heavily infested with root-eating insects or larvae such as June beetle larvae and strawberry root weevils. Intensive cultivation at least 1 year prior to tree planting will starve out most of these pests.

Three-year-old true fir planting stock (2-1 or 3-0) is usually recommended. The extra cost compared to two-year-old seedlings is justified by more rapid development and decreased first year's mortality in the plantation. Seedlings with small diameter stems and weak tops or root systems should be sorted out before planting. These can be either discarded or developed for an additional year in a transplant bed, which provides a handy source of seedlings to replace mortality in the field. Transplant beds may also be used to develop 2-0 seedlings to larger 2-1 stock for next year's planting. Although some growers develop their own transplant beds at home, most growers find it pays to contract this job to a commercial nurseryman who can often do a better job at less cost. Planting stock is packed in tight bundles or packed in waterproof bags at the nursery for convenience during shipment. Wet moss or other absorbent material is placed around the roots to protect them from drying. Water should be poured through both ends of open-ended bundles as soon as they arrive to replenish water lost during shipment. Bundles or bags of trees should be stored temporarily outdoors in a cool, protected spot. Unless trees are planted within about a week after delivery, they should be either: (1) removed from the bundle or bag and heeled in where there is sufficient moisture, shade, and protection from drying winds, or (2) stored in a 34° to 38° cold storage room until ready to plant. Open-ended bundles will require occasional watering or high humidity cold storage conditions to prevent drying.

A home seed bed is one means of controlling seed source. It also insures a fresh, adequate supply of planting stock. The bed on the left is being sown with noble fir seeds. The bed on the right contains one-year-old seedlings.

Planting, whether by hand or machine, requires special techniques for good survival. Spring planting is usually preferred to fall planting, especially on heavy clay soils which are susceptible to frost heaving conditions.

A 5-foot by 5-foot spacing is commonly used for producing the popular 6- to 7-foot tree heights. Some growers prefer somewhat wider spacing up to 5½ by 5½ feet to permit easier operation of their equipment between the rows or to provide more open sunlight around the lower branches. A few growers have increased the yield in their true fir plantations by spacing the trees 2-½ to 3 feet apart within each row. Every other tree is harvested for table top size when they start to crowd. The balance of the stand is developed into larger sized trees.

Perfect spacing of trees to form check rows in each direction has the advantage of permitting cultivation and mowing in two directions. However, many growers do not believe the additional cost of check row planting is justified. They prefer instead to space the trees randomly in straight rows, and rely on chemicals or one-way cultivation and mowing to control grass weeds. When check rowing is the preferred method, it can be accomplished by premarking the cultivated field in squares or hand planting along a wire marked at proper intervals. Machine planting is much faster and usually somewhat less costly than hand planting, but it makes check rowing more difficult.

Roadways are needed through the plantation to provide access and fire protection. These can be provided by skipping the planting of two adjacent rows of trees at intervals of every 20 to 30 rows.

E. GRASS AND WEED CONTROL

True fir Christmas tree plantations should be kept free of grass and weeds for the entire rotation. Grass and weed competition harms the trees in four ways.

1. It forms a canopy of shade that suppresses and deforms the lower branches. Open sunlight is required for adequate growth and attractive needles.

2. It depletes moisture and nutriments from the soil. Adequate summer moisture and nitrogen is required for good growth, color, and survival.

3. It provides a habitat for meadow mice, gophers, rabbits and other destructive rodents.

4. Accumulated dry grass and weeds create a fire hazard.

Frequent cultivation for the first 3 or 4 years after planting was, until recent years, the most common practice for controlling grass and weeds. Chemical herbicides, particularly atrazine, are now either replacing or supplementing cultivation for doing this job on many plantations. They usually prove less costly and more effective than cultivation alone. Moreover, they permit vegetation control around the base of the trees where cultivation is difficult.

Atrazine is most economical when sprayed as a wettable powder suspended in a water carrier. It is also available in liquid form, which requires no agitation in the spray tank. It is effective both as a pre-emergent spray (kills grass and seed sprouts as they germinate) and as a post-emergent spray (kills existing cover of grass and weeds). However, it is ineffective for certain plants such as bracken fern, Canada thistle, wild blackberry, orchard grass and alta fescue grass. Atrazine-resistant species require carefully controlled spot spraying with aminotriozole or other selective grass and weed killers, summer mowing or summer cultivating between the trees.

Atrazine should be applied uniformly over newly planted areas as soon as possible after planting. It should usually be reapplied annually in early March. Atrazine can be applied directly over dormant trees, even those that are newly planted, without causing damage. In fact, trees metabolize this chemical and often show improved color and growth after its applications.

Effective grass and weed control by either chemical herbicides or cultivation conserves soil moisture and prevents shading of the lower branches. This practice shortens the rotation and at the same time improves color, vigor and bud formation.

Usual rate of application is about 4 pounds per acre (bag weight) on sandy or gravelly soils and about 5 pounds per acre on heavier clay-loam soils. However, heavier rates of up to 10 pounds per acre on clay soils and 7 pounds per acre on sandy soils may be necessary to control moderately atrazine-resistant plants such as quack grass, perennial ryegrass, tarweed and Queen Annes lace. Atrazine is usually applied as a wettable powder by helicopter, airplane, or tractor-drawn boom sprayer equipped with agitators. Some growers reduce erosion on severe slopes by spraying in strips or 3-foot circles around individual trees; then mowing the intervening grass strips. However, broadcasting the entire area will usually save time and money in ordinary situations. Detailed instructions for use of herbicides should be obtained from your local farm forester or extension agent.

Subteranean clover was established between the tree rows to raise the nitrogen level of the soil, control erosion, and prevent muddy harvesting conditions. Note the circles of bare ground around the driplines where atrazine was sprayed to reduce competition for sunlight and moisture.

Mowing, cultivating or applying selective herbicides between the rows with a low-profile sprayer can be used to control atrazine-resistant vegetation that sometimes becomes established after the third or fourth growing season. The equipment must be narrow and the trees should be basal pruned in advance to avoid mechanical or chemical injuries to the lower branches.

F. INSECTS, DISEASES, AND MORTALITY RESULTING FROM SOIL MOISTURE STRESS

1. Aphids are the most troublesome *insects* in true fir Christmas tree plantations. Both grand and noble firs are susceptible to large, long-legged black aphids (*Contarinia* spp.) that gather in clusters on the stems and leaders. They feed on the sap and reduce growth of the tree. They also secrete a honeydew which produces an unattractive sooty black mold on the twigs and needles. Another species imported from Europe, the balsam woolly aphid (*Adelges* spp.), is partial to grand fir and concolor fir. Swollen, stunted, deformed twigs result. Aphids may be controlled by spraying with malathion, thiodan, or diazinon. Aphid control is more effective, less costly, and less damaging to tree quality when it is carried out at the very first sign of an outbreak rather than waiting until a plantation is badly infected. Early infections can frequently be controlled by spot spraying individual trees, whereas heavy infestations may require aerial or boom spray applications.

2. Various *diseases* infecting needles, stems and roots have been a serious problem in many true fir plantations. Some of the more troublesome diseases are described below:

a. Needle rusts cause elongated spore blisters on the undersides of the needles during early summer. By late summer or fall the infected needles usually develop brown spots and sometimes shed from the twig. Concolor fir and grand fir are more susceptible to needle rust diseases than noble fir and Shasta red fir. A particularly serious rust disease on concolor fir and grand fir is *Uredinopsis pteridis*, which alternately infects bracken fern. Susceptibility to needle rust varies with seed origin. Southern and central Oregon grand fir strains, for example, are less resistant than more northerly strains. Northern Idaho strains of grand fir are among the most resistant seed sources. Concolor fir from southern and central Oregon seed origins are more susceptible to rusts than central California and southern Rocky Mountain origins.

Needle rusts are cyclic in occurrence. A plantation may show only light infection, or even absence of infection for several years and then suddenly develop a severe infection with defoliation. Heavy infection years are believed to result from wind and moisture conditions that cause spores to spread and cling to damp needles. Just as suddenly, rust infection may clear up during the following summer, if more favorable weather conditions prevail.

No practical chemical treatments are known for rusts. Purchase of seedlings from rust-resistant strains appears to be the best way to reduce the chances of infection.

b. Stem cankers (*Phomopsis*) cause swellings or roughened areas of dead cambium that girdle the main stem. Shasta red firs, and to a somewhat lesser extent, noble firs, are most susceptible. This disease is commonly associated with poor site conditions such as droughty soils, water-logged soils, or heavy grass competition. Planting trees on moist, but well-drained, fertile north and east ex-

The first indication of needle rust is white spore blisters on the under sides of the needles in spring and summer.

Rust infection is followed by browning and shedding of needles during late summer and fall.

posures and maintaining good grass and weed control are the most effective preventative measures. Once infection sets in, salvage as many trees as possible before they die. Then replant the area to another species such as Douglas-fir or Scotch pine.

3. **Excessive Soil Moisture or Drought.** Noble fir and Shasta red fir both have a narrow tolerance for moisture. Shasta red fir tolerates drought better than noble fir, but noble fir is more tolerant of excessive soil moisture. However, mortality unrelated to insects and diseases has been observed for both species where winter wet spots or flooding occurs and where summer drought occurs. We are indebted to the State of Washington Department of Natural Resources for the following information:[3]

Noble fir and Shasta red fir, but particularly Shasta red fir, show poor growth and high mortality on excessively wet soils. First symptoms of damage are slowing of growth followed by yellowing and eventually browning of the entire crown. The cause of dying may at first be puzzling to the grower because the stems, branches, and needles show no outward damage other than a gradual drying. However, examination of the roots shows dead cambium without evidence of a primary disease, although a noticeable root swelling sometimes occurs just below the ground line. The best solution is to refrain from planting these species in wet areas. If wet spots must be planted, consider Scotch pine or shore pine, which are relatively tolerant of wet soils.

Both species, but Shasta fir to a much lesser degree than noble fir, are susceptible to damage from drought. Two types of drought – soil and atmosphere – may occur. Each will be described separately.

Soil drought symptoms are somewhat similar to those caused by root rots. Trees tend to droop and fade during extended periods of drought. The new growth sometimes takes on a "shepherds crook" appearance. The crown dies rather evenly and eventually turns red. The roots are last to die and sometimes appear outwardly healthy, or at least not diseased, after the crown dies. The best solution is to keep the plantation free of grass and weed competition, and to water at 2- to 4-week intervals during periods of extended summer drought. If watering is impractical, plant trees only on cooler, moister sites. Good prospects are northerly and easterly exposures, higher elevations, and well-drained soils with good moisture retention.

[3] Kenelm W. Russell, Forest Pathologist, Washington State Dept. Natural Resources, reports of May 2 and May 16, 1972.

Atmospheric drought occurs when needles lose water faster than it can be replaced by the roots. It most frequently occurs during periods of hot, dry summer winds or drying winter winds when the ground is frozen. Trees are particularly susceptible in early summer when the new growth is still succulent and most susceptible to dehydration. In this case the tips of the tender needles or shoots die back, but the tree usually recovers. Symptoms of atmospheric drought are dying and browning of the needles from the tips back. The tree may look like it is seared, particularly on the top and exposed sides. Severe conditions may cause the entire tree to die from the top down, with the roots the last portion of the tree to die. Atmospheric drought is associated with adverse weather conditions and, therefore, it is difficult to predict or control. One solution is to plant pines instead of true firs on exposed ridge tops and southwest exposures where winds or temperature extremes are most likely to occur.

G. DESCRIPTION OF CULTURAL PRACTICES

There would be little need for this section if growers could merely plant true fir seedlings and depend on nature to develop them into high quality Christmas trees. True, a small percentage of true firs in most plantations seem to develop beautifully and spontaneously without a helping hand by man. Most of us have admired those occasional uncultured trees with 10 to 14-inch annual leader growth, uniform whorls of five or six branches, and near-perfect cone shape. But what about the other 90% of the trees that develop excessively long leaders, sparsely arranged branches, imperfectly shaped crowns or other serious problems? After all, the financial success of a Christmas tree operation will depend to a much greater degree on conversion of potential cull trees to marketable quality than on harvesting only those scattered trees that shape up naturally without corrective cultural work.

This section will describe several effective cultural practices for improving symmetry, taper, shape and density. The two general methods for doing this are shocking and shearing.

1. **Shock Treatments.** Shock treatments deliberately injure a tree to reduce its vigor and slow its future leader and branch growth. Trees that are shocked develop a more bushy, compact appearance because the spans between branch whorls are reduced. The one advantage of shock treatments over shearing is the "natural look" of uncut branch tips and pronounced openings between the branch whorls. However, many growers find that it is very difficult to judge the degree of shock that is needed to attain the desired retardation of future growth. If trees are over-shocked, they become stunted and sometimes develop an unthrifty appearance. On the other hand, if trees are under-shocked, they tend to retain their excessive growth rate characteristics. To make shock treatments even more complicated, growth reduction after treatment will vary from year to year with weather conditions during the growing season. Response will also vary from one plantation to another where site conditions (growth rate capacity of the land) vary. Despite these complications, shock treatments, when properly applied, are quite effective and widely used by successful true fir growers. Some growers develop an almost uncanny ability to judge the proper type and degree of shock needed to accomplish a desired slowing of future growth.

The more commonly used types of shock treatments are described below:

b. **Basal pruning** is the removal of unwanted branches between the bottom whorl of the Christmas tree and the ground. The pruned stem should provide for a reasonable straight handle of at least 1 inch per foot of tree height for insertion into the tree stand. It should be sufficiently high to avoid serious defects such as incomplete bottom whorls and crooked stems. The branches should be cut flush with the stem to avoid both stubs and heavy scars. Hand pruners, and sometimes short machetes or heavy knives, are commonly used for basal pruning.

The selected bottom whorl should preferably contain five or more uniform, well-distributed branches in a main whorl. Sometimes, however, the only available prospects for forming a bottom whorl contain only three or four branches instead of five. In such cases, the deficient whorl must be "backed-up" by several strong internodal branches just below or

above the main whorl to complete the whorl pattern and help fill the gaps. Distance between the ground and the selected bottom whorl may be only 8 to 12 inches in well-cared-for plantations where grass and weeds are effectively controlled by chemicals, cultivation or mowing. Where the competing vegetation is not effectively controlled, the bottom whorl should be located sufficiently higher on the stem to place it above the level of heavy shade.

Basal pruning provides several other important benefits besides forming a handle. It defines the usable portion of the crown, exposes the bottom whorl to sunlight, and it facilitates mowing, cultivating, spraying, fertilizing and harvesting.

Last, but not least, basal pruning provides an effective means of shock treatment to help control future excessive growth. It is used more than any other shock treatment because so many side benefits are derived. In fact, basal pruning alone, without any additional shock treatments, frequently accomplishes adequate growth control. If excessive growth rates continue, most growers follow up basal pruning with shearing. However, some growers prefer to follow up with other shock treatments to maintain an unsheared appearance.

When to start basal pruning is important. If done when the tree is too small, it may overshock the tree and appreciably stunt next year's growth. If postponed too long, the shock effect will come too late to prevent excessive leader growth. Basal pruning too late will also increase pruning costs by requiring

Basal pruning improves quality by forming an adequate handle above a strong, symmetric bottom whorl. Unwanted lower branches should be cut flush with the stem below the selected bottom whorl.

This noble fir is not ready for basal pruning. Annual growth is less than 12" per year. Premature shocking would cause further stunting and delay its harvest by several years.

This noble fir is ready for basal pruning as indicated by the 14" leader. If the tree is not shocked at this time, next year's leader is likely to grow excessively long.

the cutting of heavier branches and will allow insufficient time for visible branch scars on the handle to heal and for the bottom whorl to overcome a suppressed appearance on the underside.

A good rule of thumb for the proper time to basal prune a true fir is to wait until a leader more than about 12 inches long first develops. This stage of development frequently occurs after three or four growing seasons in the plantation. Basal pruning may be done any time of the year, but extra care must be taken to avoid breaking tender shoots during the succulent stage of new growth.

Basal pruning during the previous year effectively controlled growth of this noble fir. Had the tree not been shocked, indications are that the leader would have been about 18" long instead of 13".

A growth control study for noble fir[4] showed a growth retardation of 21% during the first growing season after removing 50% of the live branches by basal pruning. Retardation was even more, 25%, during the second growing season, and continued to a much lesser degree into the third growing season after treatment.

If complete basal pruning would be apt to cause over-shock, it could be done in two stages. The first stage should establish the bottom whorl of the Christmas tree and progress downward from this point until the desired number of branches are removed. Defer pruning the remaining branches until the tree has made another season's growth.

b. **Leader scarring** is accomplished by slicing two strips of bark about 1 inch long from the base of a leader to slow future leader growth. A 50% girdle will provide light shock and about 10% height retardation of next year's growth. An 80% girdle will provide up to 20% height growth retardation. Its main application is further slowing of growth of noble firs and Shasta red firs when basal pruning alone does not provide adequate shock.

This leader was scarred by peeling two strips of bark from opposite sides near the base of the leader. It is a means of providing additional shortening of next year's leader where basal pruning alone would not provide sufficient shock to accomplish a desired 12" leader.

The duration of shock from leader scarring is only one growing season. Unlike basal scarring, it does not retard growth of the entire tree, just that portion of the tree above the scar. In fact, leader scarring actually stimulates growth below the scar by diverting growth energy into the lower portion of the tree. Caution: do not slice deeper than the cambium layer. Cutting into the wood weakens the stem and may result in snow-break or

[4] Study made in Clackamas County, Oregon, by Bernard Douglass, Alvin Parker, Clayton Wills, and Harry Roumsefell 1961 - 1963.

wind-break.

c. **Basal scarring** is the slicing of a strip of bark about 2 to 4 inches long from the base of the main stem below the bottom of the handle. Light scarring would girdle about one-half of the stem; heavy scarring would girdle about 80% of the stem. Growth control experiments on noble fir[5] produced 21% reduction of next year's leader growth when using a scar that girdled 50% of the tree stem. Basal scarring is not as widely practiced as leader scarring to produce shock because it is more costly and requires extra high basal pruning to prevent disfiguring of the handle. Like leader scarring, it is effective for only one growing season and its use is largely restricted to noble firs and Shasta red firs.

d. **Root pruning** accomplishes shock similar to that of basal scarring. However, the shock effect is more severe and it remains effective for three growing seasons instead of just one. It is accomplished by cutting the surface roots the depth of a shovel blade about two-thirds the distance from the stem to the drip line. A sharp, square-pointed shovel is an effective tool. The roots are normally pruned on only one side or two opposite sides of the tree. A complete circular cut entirely around the stem tends to over-shock the tree and cause severe stunting and yellowing of the needles for at least 1 year. Growth control experiments on noble fir[5] produced 27% reduction of next year's leader growth when 50% of a complete circle was root pruned. Growth reduction was 36% the second year and 21% the third year.

Root pruning, like basal scarring, is normally used only as a last resort on noble firs and Shasta red firs when basal pruning, followed by leader scarring, fails to produce an adequate degree of shock. Most growers are discontinuing both root pruning and basal scarring in favor of shearing as a means of maintaining control of shape, height, and density.

2. **Shearing.** Shearing consists of removing unwanted tips of leaders and lateral branches to improve tree quality. Shearing is an effective means of correcting excessive leader length, excessive width, lopsidedness, faulty cone shape, and inadequate density when trees do not shape up well naturally. Although many consumers still prefer the completely natural look of the unsheared tree, growing numbers are leaning toward the more bushy, compact sheared type. In response to this changing market demand, more and more true fir growers are beginning to shear at least a portion of their trees.

Some growers shear the tops of all their trees as a separate operation before starting to shear the sides. Others combine both jobs as part of the same operation. In either case, the techniques are the same. Top shearing should precede side shearing to establish the top of the cone and provide a guide for shearing the lower portion of the cone.

This Shasta red fir grades below U.S. No. 2 because of excessive whorl spacing. Timely shearing to improve density could have resulted in a U.S. Premium or U.S. No. 1.

Top shearing consists of cutting back excessively long leaders and removing multiple leaders, together with cutting the tips of the top whorl to proper length and proportion. Hand pruners are effective tools for this job. They permit close control in making the cuts in proper relation to the position of internodal buds.

Side shearing consists of cutting back the tips of the lateral branches to complete the cone shape to a desired percent taper. Several types

[5] Study made in Clackamas County, Oregon, by Bernard Douglass, Alvin Parker, Clayton Wills, and Harry Rounsefell 1961 - 1963.

of tools are used, including hand shears, shearing knives, hedge shears, and electric and gasoline motor operated power clippers. Choice of tool will depend on the species being sheared and the technique of shearing that is selected.

Since shearing techniques for noble and Shasta red fir differ somewhat from grand fir, each will be described separately.

a. **Noble fir and Shasta red fir shearing techniques**. Ideal annual leader growth is 10 to 14 inches. It is usually better, however, to retain natural leaders up to 15 or 16 inches in length rather than to cut them back. Reason: The base of the new leader arising from the top bud of a sheared leader sometimes forms an unsightly crook or offset called a "dogleg." Also, the first year's terminal bud set of this new leader frequently contains only three or four buds which produce an unsymmetrical whorl. These leader shearing problems are more pronounced on noble and Shasta red firs than on other species. They can be minimized by shearing during the early summer succulent stage when new growth is in the brittle stage during its final stage of elongation, rather than later in the season. Succulent shearing allows the terminal bud to become more erect on the stem. It also fre-

Pointed out is a top internodal bud on a Shasta red fir leader several months after it was succulently pruned to correct excessive length. Note that the bud has enlarged somewhat and has assumed a more erect position on the stem.

A new leader formed from the top bud one year after succulent shearing. No top shearing is required at this time because the new leader is less than 12" long, reasonably upright, and contains a terminal bud surrounded by a rosette of five lateral buds.

quently causes internal changes to occur in the bud structure which result in a normal five-bud terminal bud cluster the following year.

Detailed instruction for shearing the leaders of noble fir and Shasta red fir follow: Locate a cluster of internodal buds on the leader, preferably about 10 to 14 inches above its base. Try to locate a single internodal bud 2 to 4 inches above the cluster to form the new leader. If such a bud cannot be found, select the top bud in the cluster. For succulent shearing the cut may be made immediately above the selected top bud. For dormant shearing a 2-inch stub above the bud is recommended for tying the new leader erect with plastic flagging in case it does not grow perfectly straight and vertical. If the sheared leader develops multiple leaders, all except the best one should normally be removed. An exception would be where complete removal of the competing leaders would leave an obvious gap in the branch structure. In this case, cut the unwanted leaders back severely just above an "out-pointing" bud.

Growers are frequently tempted to shear the tips of the top whorl to correct a flared shape near the top of the crown. However, a better practice in most cases is to defer shearing the

top whorl for 1 year. This will permit time for the lateral branches to form nodal forks during their second growing season. Shearing *above* these forks will noticeably improve the symmetry and naturalness of the sheared branch structure. Some growers, too, are apprehensive that the branches in the top whorl would turn up and form multiple leaders if the leader were shortened without also cutting back the branch tips. However, true firs will react differently than Douglas-firs in this respect. If even a portion of a true fir leader is retained, the branches in the top whorl tend to remain in their original horizontal position.

Two exceptions to the above rule may occur. One would be where the top whorl is so abnormally long that permitting it to grow naturally for another year would completely spoil the balance of the tree. The other would be if the tree was to be finish sheared during the summer or fall prior to its harvest. In this case, the grower's main concern is forming a symmetric, cone-shaped tree ready to market, rather than preparing the tree for another growing season.

After the leader and top whorl have been sheared, it is usually necessary to also shear

Any lateral branches that are abnormally long or upright may be corrected by nipping off their tips. Removing more than just the terminal buds is risky except on extremely wide trees because it virtually halts future elongation of the pruned branch for a year or two.

the sides of the tree to maintain good proportion and to prevent excessive width. Three methods of side shearing will be separately described — random shearing, fork shearing, and disbudding. More than one method may be practiced on a single tree to bring out its best response. For example, branches that need drastic shortening may be fork sheared; those that need only slight shortening may be disbudded; and those that need lengthening may be left unsheared in order to catch up with the others.

(1) **Random shearing** consists of narrowing and shaping the crown to a uniform cone by cutting all 1-year-old branch tips that project beyond the general desired cone shape. No attempt is made to make the cuts in relation to the position of individual buds. A thin, sharp shearing knife is the most commonly used tool, but a hedge shear or power clippers may also be used. Some growers prefer to snip off individual terminal bud clusters with a hand pruner or to snap them off with their fingers during their succulent stage of growth.

(2) **Fork shearing**. Cuts are made in relation to individual buds or branchlets. A hand pruner is used to remove tips of individual lateral branches just above a fork formed by oppositely arranged secondary branches or buds. Sufficient branch tip should be removed to attain desired crown width and uniform cone shape. Heavy fork shearing may actually cut into 2- or 3-year-old wood where extreme narrowing of the crown is needed. Medium form shearing would remove the entire terminal branch tip. Appearance is most pleasing and resistance to splitting greatest where the cut can be made just above a branchlet arising from the bottom of the main branch, as well as oppositely arranged branchlets on the sides of the main branch. Light fork shearing removes only a portion of the terminal branch tip. The cut should be made just above oppositely arranged side buds, or better still, a bud arising from the bottom of the branch. Do not leave a bud on the top side of a sheared lateral branch tip because it will develop into an unsightly in-pointing branch. Fork shearing, like ran-

dom shearing, may be carried out anytime except during the early succulent stage. However, as mentioned previously, shearing during the late succulent stage provides some advantages for leader response.

Fork shearing removes individual lateral branch tips to improve shape and prevent excessively wide trees. New growth from secondary branches is symmetrical and fan-shaped.

(3) **Disbudding** consists of removing one or more buds from the bud cluster at the tip of a main lateral branch. As a minimum, it picks off the terminal bud plus any bud arising from the top side of the bud cluster. Time can be saved by cutting or pinching off the entire terminal bud cluster. A few growers develop sufficient skill with a shearing knife to flick off the terminal bud cluster with extreme accuracy, but most growers depend on using their fingers or hand pruners. Branch growth resulting from disbudding is similar to fork shearing, but less drastic. Disbudding the tips of the largest main laterals enables a grower to improve the shape of the tree and stimulate internodal branch growth in such a subtle manner that the tree will appear to be unsheared. Growers frequently combine disbudding with fork shearing on the same tree where some branches need more drastic shortening than others.

b. **Grand fir shearing techniques.** Three types of grand fir are produced in Northwest plantations: unsheared, light sheared, and heavy sheared. The unsheared and light sheared types are produced largely on slower growth sites. Acceptably short leaders may be attained on some trees by the shocking effect of basal pruning alone. Other trees do not respond sufficiently to basal pruning and require light cutting of the leaders and longer branch tips. Trees developed in this manner retain visible internodal spaces between whorls and a more or less natural look. Techniques for this light shearing of grand fir are about the same as those previously described for noble fir and Shasta red fir.

Heavy sheared grand fir are usually grown on faster growth sites where few trees would develop adequate density without a shearing program. However, trees that fail to develop adequate density on low sites may be fertilized and sheared to stimulate internodal growth. Heavy sheared trees are in growing demand by consumers who prefer trees with dense crowns. Method of shearing is quite similar to that used to develop sheared plantation-grown Douglas-firs. Instructions follow:

(1) Basal prune when the trees attain sufficient size that removal of the lower branches will not eliminate more than one-third of the total foliage. At the same time, shear the sides of the tree (but not necessarily the leader) to form a perfect cone with a taper of about 50%. Once side shearing is started, it should be repeated every year thereafter until the tree is ready to harvest.

(2) When the total height of a tree above the base of a 6-inch handle first exceeds about 5 feet, reduce the height to approximately 5 feet by cutting back the leader. Make the cut above a single internodal bud located above a cluster of internodal buds. Grand firs develop more prolific internodal buds than any other true fir species. Shear the balance of the tree to form a cone with a taper of about 50%.

(3) During the following year, cut the leader to about 12 inches long and continue side shearing.

(4) During the last year of shearing, cut the leader to whatever length gives the best proportion. This is commonly 8 to 10 inches. At the same time, side shear very lightly to form a stub-free,

natural appearing cone. Lighter side shearing together with shorter leader shearing will expand the taper of the cone from about 50% to about 60%. Most trees should now be ready to harvest.

(5) Recommended season of shearing is during the late succulent stage after the new growth has fully elongated. Shearing the leader at this time causes the top bud to grow more erect during the summer. Where it is necessary to shear during the dormant season, leave a 2-inch stub above the selected top bud on the leader. This stub will serve as a post to bind the new leader into an upright position if it tends to lean.

3. **Removing Multiple Leaders and Suckers**. Nine times out of ten, the best solution for multiple leaders is to completely remove all except the best one as soon as they are observed. Selection should be made on a basis of size, vigor, branch arrangement, and terminal bud set. The competing leaders should be cut out completely where they join the main stem. The exception would be where complete removal would leave a noticeable opening *above the bottom whorl*. In this case, the entire multiple leader should be removed *except an out-pointing branch* near its base to help fill the opening.

The same rule applies to suckers, which are actually smaller multiple leaders formed by upturned branches rising vertically from the main stem. One might quote the late P. T. Barnum who advised, "Never give a sucker an even break!" Complete removal of a sucker is almost always the most satisfactory solution. Removing only the top half or terminal of a sucker will seldom arrest its abnormally vigorous and haphazard growth characteristics, which distract from the appearance of a tree.

4. **Replacing Lost Leaders**. Aborting of the center leader bud or mechanical injuries by birds, animals or equipment may cause true firs to lose their leaders. When this happens, several branches of the top whorl may turn upward and form multiple leaders. Needless to say, this spoils the symmetrical appearance of the tree unless remedial action is taken. Caution: Sometimes regrowth (lammas growth) will occur from the terminal bud cluster of a leader in late summer. This causes whorl branchlets instead of normal buds. When lammas sprouts occur, a frequent problem is elongation of one or more of the lateral buds instead of the center bud, which may appear dead or aborted. Actually, it is usually alive and, if left alone, will usually catch up

A late summer flush of regrowth is shown on a terminal bud cluster. It most frequently occurs after irrigating or heavy summer rains. Regrowth sometimes occurs on only one or two lateral buds. Shearing to correct the resulting unsymmetrical appearance is most effective if deferred until the late succulent stage of the following growing season.

A 13-gauge aluminum wire is spiralled around a bent leader during its late succulent stage of growth to hold it in an upright position. The training wire must be removed before next growing season.

with the sprouted laterals next growing season and form a normal leader.

A lateral branch can be trained to replace a lost leader by prompt treatment, preferably in July or August. Instructions follow: A strong, closely spaced lateral branch in the top whorl should be selected for the new leader, preferably one backed up by a strong internodal branch growing directly below it. It should be bent to a vertical position and held in place with a loose spiral wrapping of aluminum wire or by a splint. When a wire trainer or splint is used, it will need to stay on the tree 2 or 3 months before the branch "sets" in a vertical position. The wire must always be removed prior to the next growing season to prevent strangulation of the leader. At the same time, the tips of the other top whorl branches should be disbudded or cut back slightly to prevent them from turning up and forming multiple leaders. A leader formed by a turned up branch tends to have a three-sided terminal bud set. This causes a somewhat three-sided top whorl the following year, but future leader growth will revert to a complete rosette of terminal buds. A three-sided top whorl can be de-emphasized by cutting back or disbudding the longest laterals to allow the shorter laterals to catch up.

5. **Stump Culture.** Stump culture is the practice of developing a new tree from a small limb or sprout on the stump after a Christmas tree is cut. A year or two after the tree is cut, the sprouts will turn upward and form multiple leaders. The most promising one is then selected to produce a new tree, and the competing sprouts are gradually removed to insure dominance of the selected sprout.

Stump culturing is recommended where planted trees are difficult to establish or slow to develop. Using an established root system of a cut tree may reduce the rotation age of the next crop of trees. It also permits establishment of an uneven aged Christmas tree plantation, such as a choose-and-cut operation where Christmas trees may be harvested off the same area year after year. Stump culturing is much more frequently practiced on natural areas than on plantations. It does have some potential for perpetuating a planted stand of genetically elite trees.

True firs are reluctant to form a new stump cultured tree from an upturned branch. Much better results are obtained by lopping back the tips of the branches to encourage forma-

Birds broke off the leader several months ago during its succulent stage. Note the tendancy of the lateral branches of the top whorl to grow erect and form multiple leaders. How to correct this deformed tree top presents a problem. One method of replacing the leader would have been to use a wire trainer to hold one of the lateral branches upright; then cutting back the tips of competing branches.

An alternate method was actually used to replace the lost leader. It was favored by presence of buds on the leader stub. Tips of all branches of the top whorl were cut back to restore good proportion and to force growth of a new leader from one of the buds.

tion of a new sprout from the stump. The sprout will grow erect and form a perfect terminal bud set much sooner than a branch whose only purpose is to sustain the vigor of the root system until a sprout is produced. A good rule of thumb on the amount of branches necessary to leave on the stump to keep the root system alive is at least 10% of the total live crown of the tree. The best time to select branches on the lower stem for future stump culturing is when the trees are being basal pruned.

Normally, only a partially suppressed whorl next to the ground needs to be retained. Branches in this whorl will increase in size and vigor during the period that the Christmas tree is growing to marketable size. It may even be necessary to cut their tips back if they interfere with mowing or cultivating, or grow upward into the lower whorl of the Christmas tree. Sometimes vertical adventitious sprouts form below the handle a year or two before the Christmas tree is harvested. These should be encouraged because they will give the new stump cultured tree a year or two head start.

Stump culturing is sometimes used to replace a cut tree without replanting. It consists of saving a few branches in the stump below the handle to keep the roots alive. Cutting back the branch tips will help force adventitious buds from the stump, which develop into a new tree much more readily than an upturned branch.

Four sturdy sprouts have formed on this stump 1 year after cutting. Only the sprout with the best terminal bud cluster will be retained to form a new tree. Competing branches will be gradually trimmed from the stump as the new tree develops.

6. **Fertilizing.** Some cleared lands, formerly under cultivation, contain sufficient nutriments for good Christmas tree vigor and color without fertilizing. However, chlorotic (yellowish) needles, sparse buds and excessively slow growth rates may persist dispite adequate grass and weed control. This is a fairly reliable indication of a nutritional deficiency.

Fertilizers must be used with caution. Overdoses may injure the roots, cause excessive growth, or stimulate rank growth of grass and weeds. Experimental applications of 1/16 – 1/4 pound (actual nitrogen) per 6-foot tree should be made to determine the least amount per tree needed to obtain desirable color and vigor. Heavier applications of fertilizers are needed on clay soils than on sandy soils. *Large-scale applications should not be made until sufficient small trials have proven the effectiveness under local conditions.*

Straight nitrogen fertilizers have in most cases proven equally effective and less costly than balanced fertilizers. Commonly used nitrogen fertilizers are urea, ammonium nitrate and ammonium sulphate.

Fertilizer should be scattered evenly under the drip line of the tree in late winter or early

spring before the buds have burst. Proper amounts of nitrogen will cause deficient trees to develop heavier, darker green needles and a noticeable increase of internodal buds after one growing season.

Increased leader growth will be only slight during the first growing season, but frequently doubles during the second. Therefore, the safest time to apply nitrogen on unsheared or lightly sheared trees is in March or April of the same year that the tree will be harvested. Another advantage of deferring fertilizing until the year of harvest is obtaining maximum color response which always occurs during the same year that the nitrogen is applied.

Four ounces of urea were spread under each noble fir to increase its vigor and bud production. Although the larger trees were improved, a number of smaller ones died from nitrogen shock. Mortality could have been prevented by adjusting the amount of fertilizer for each tree according to its size.

Another use of nitrogen is for stimulating vigor and growth of stunted or unthrifty trees on poor sites. Two precautions should be observed in fertilizing younger plantations.

a. Do not fertilize the same year that trees are planted. Roots at this time are easily damaged by even small applications of nitrogen.

b. Use nitrogen sparingly on small trees. Overdoses will burn the roots. Trial applications should be made around the drip lines of a few trees to determine the correct amount to stimulate adequate growth without killing the roots.

H. NUMBER OF YEARS REQUIRED TO GROW A MERCHANTABLE TREE

Rotations for growing true fir Christmas trees will vary with species, site, and intensity of culture. Harvesting is usually spread over a period of 3 or more years because all trees do not develop uniformly.

The rotation ages shown below are considered average for intensively managed plantations on Site III lands. Estimated percentages of total cut for each year of an assumed 3-year harvesting period are also shown.

Percentages of Total Merchantable Trees Harvested at Various Plantation Ages

Species	Number of Growing Seasons					
	7	8	9	10	11	Total
	----- Percent of Total Harvest -----					
Grand fir	20	40	40			100
Concolor		10	40	50		100
Noble fir		10	40	50		100
Shasta red fir			10	40	50	100

I. STEP-BY-STEP CULTURAL INSTRUCTIONS

1. **After First Growing Season.** Concentrate only on keeping trees alive, healthy and growing.

The only pruning would be removing double leaders. The choice of multiple leaders to save should be based on its vigor, erectness, number of internodal buds, and completeness of terminal buds.

Weed and grass control is essential for good growth and survival.

Watering during prolonged summer drought periods may make the difference between good and poor survival.

The first summer's mortality should be replaced during the regular planting season with the same species originally planted. Replacement stock can be developed in a transplant bed, where 5–10% of selected smaller trees from the original planting stock are held.

2. **After Second Growing Season.** Same general instructions as for "After First Growing Season."

True firs develop slowly and are unlikely to require pruning at this time.

When Atrazine is used to control grass and weeds, it should be applied between February 15 and March 30. When cultivation is the chosen method, it should be repeated as often as necessary to leave the ground clean.

Supplementary watering may usually be discontinued after the first growing season when the root system becomes well established.

Mortality should be replaced with planting stock of the same species from a nursery or transplant bed. It should be large-sized and thrifty to reduce the spread in tree sizes, and thus the cutting rotation. However, persistant mortality spots caused by shallow bedrock, sterile soil, or poor drainage should be either left unplanted or replanted to Douglas-fir, shore pine, or some other more tolerant species. Replantings of true firs would likely die for the same reason that the original planting failed.

3. **After Third Growing Season.** Weed and grass control should continue.

Most seedlings will not require pruning except for removing multiple leaders. A few exceptionally fast growers may have developed leaders longer than 12 inches. These may be basal pruned to prevent excessive next year's growth and to start a handle. However, in order to prevent overshock and stunting, *not more than 1/3* of the total live branches should normally be removed in any single year.

4. **After Fourth Growing Season and Thereafter Until Trees are Harvested.** Weed and grass control, if by herbicides, should continue. Weed and grass control, if formerly by cultivation, should now be replaced by mowing, aerial application of herbicides, or a combination of mowing between the rows and spraying herbicides under the drip lines. Do not basal prune trees when leaders are less than 12 inches long. They need their full crowns for adequate growth.

Basal prune trees that develop leaders longer than 12 inches. Where an unsheared or lightly sheared tree is desired, attempt to maintain an annual leader growth of 10 to 14 inches per year by timely basal pruning and possibly additional shock treatments if they are needed to maintain this growth rate. If leaders exceed 16 inches despite shock treatments, cut them back during the succulent stage together with sufficient lateral tips to form a uniform cone.

To develop heavy sheared grand firs, side shear to a 50% tapered cone, but defer leader pruning until total height exceeds 5 feet. The leader should then be cut back to form a sheared tree approximately 5 feet tall. Strive for a 50% crown taper. Taper is defined as the width of a tree expressed as a percentage of its height.

J. CONCLUSIONS

True firs are in good demand for Christmas trees and bring top market prices. Attractive needles, heavy and symmetrical branches, and durable foliage are selling advantages. At the same time, true firs are considered the most difficult species to produce.

Relatively few Northwest growers have produced plantations of high quality true firs. The most successful growers have very carefully selected planting sites that are naturally well suited for growing true firs. They have

also cultured the trees very skillfully and intensively to attain desirable shape, density, and spacing of whorls.

Until recent years, all true firs were developed with natural unsheared crowns. This was wasteful production because many trees developed poor shape or excessively large openings between the whorls. Shearing is becoming increasingly popular to correct these defects and to increase the percentage of marketable quality trees that can be harvested from a true fir plantation. Growing numbers of consumers are beginning to accept, and even prefer, the more symmetric, dense, narrow crowns that are found on sheared trees.

K. SOURCES OF ASSISTANCE AND INFORMATION

Field services of a farm forester are available to most woodland owners in Oregon and Washington. The office address of the local farm forester can be obtained by inquiring at any State Forestry Department Office in Oregon or State Department of Natural Resources Office in Washington.

Reference material and consultation is available from County Extension Agents. They can also advise growers concerning the availability of assistance from farm foresters, extension foresters, soil scientists, insect and disease specialists, and others who work with Christmas tree growers. Their offices are located in the County Courthouse or a Federal Building in each county.

Additional sources of Christmas tree culturing information are:

Extension Forestry Specialist
Cooperative Extension Service
116 Forest Research Laboratory
Oregon State University
Corvallis, Oregon 97331

Special Products Forester
Division of State & Private Forestry
U.S. Forest Service
Post Office Box 3623
Portland, Oregon 97208

Local offices of the Soil Conservation Service

The Northwest Christmas Tree Association provides meetings, field tours, culturing demonstrations, and current literature for its members. Most Oregon and Washington growers and wholesalers belong to this Association. The name and address of the current secretary may be obtained by contacting any of the above-mentioned sources of information.

Both the Oregon State and Washington State University Extension Services provide biennial 2-day short courses for Christmas tree growers. Your local extension agent can provide information on time, place, and agenda of these training sessions.

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PESTICIDE PRECAUTIONARY STATEMENT

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key out of the reach of children and animals and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first-aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the Federal Environmental Protection Agency, consult your county agricultural agent or State extension specialist to be sure the intended use is still registered.

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Use Pesticides Safely

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